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Improving the Food Delivery System at the Queen Sirikit Centre for Breast Cancer

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Improving the Food Delivery System at the Queen Sirikit Centre for Breast Cancer

An Interactive Qualifying Project Report
Submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
In partial fulfillment of the requirements for the
Degree of Bachelor of Science
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Date: March 5, 2009

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This report represents the work of one or more WPI undergraduate students submitted to the faculty as evidence of completion of a degree requirement. WPI routinely publishes these reports on its web site without editorial or peer review.

Abstract

At the Queen Sirikit Centre for Breast Cancer in Bangkok, Thailand, the current food trolleys present a potential risk to the Centre's staff, patients, and building. Our goal was to provide recommendations to improve their food delivery system. To accomplish this, we determined the needs of each stakeholder at the Centre and designed a trolley to address these needs. We further determined a manufacturer for our potential design and provided suggestions for the successful implementation of the trolley.

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We would like to thank the following people and organizations for their help throughout our project. Without the help of those around us, we would not have been able to complete this project.

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- The management of Bumrungrad Hospital and Bangkok Nursing Home for allowing us to see their trolleys and learn about their food delivery systems
- Ajarns Chrysanthe Demetry and Richard F. Vaz for their continued help, patience, feedback, support and suggestions to make our project the most beneficial possible

Authorship Page

Kelly Johnson - Kelly served as our team's design process expert and made sure the methods used for design were executed correctly to allow us to think of all ideas. She also participated in all interviews and observational studies taking notes and asking questions. She completed manufacturing research and contacted various companies. In the report, she wrote the first draft of the food delivery and implementing change sections of the Background, the design process section and implementing change section of the Methods, and the recommendations for improving food delivery section of the Findings. She was the primary manager of our bibliography, and the technical editor of our paper to make sure that we did not make any unsupported or false claims, and that there were no unclear parts of our report.

Stacy Rudolf - Stacy was also an active member of the team during interviews and observational studies, taking notes and asking questions. She developed the initial survey questions we planned to give to the patients at the Centre, and participated in the brainstorming and analysis phase of the design process. She further researched and contacted manufacturers for the trolley. In the report, she wrote the initial drafts of the Introduction, the Centre background section of the Background, the needs assessment portion of the Methods, the needs assessment section and implementation section of the Findings, the Conclusions and Recommendations Chapter, and the Executive Summary. She served as the literary editor to make sure that the paper flowed well and was concise.

Michael Taglieri - Michael served as our primary liaison to the kitchen management and developed our team's relationship with them. He was also our team's primary photographer around the hospital and participated in interviews asking questions and taking notes. He further participated in the brainstorming and analysis phases of the design process and developed the computer models of our designs. He researched and contacted manufacturers. In the report, he wrote the first drafts of the manufacturing section of the Methods and the recommendations for manufacturing section of the Findings. He also helped to develop the food delivery systems section of the Background Chapter and wrote the first drafts of most appendices, formatted our paper, and contributed to the overall editing effort.

Executive Summary

Breast cancer is the most common cancer among women in Thailand (Attasara & Buasom, 2007). The Queen Sirikit Centre for Breast Cancer, a public teaching hospital located in Bangkok, works to address this problem by treating any patient with breast cancer regardless of his or her financial status. Currently, 90% of the women treated at the Centre are underprivileged. The Centre strives to go beyond treating the cancer, and endeavors to care for the patients as a whole, spanning from their physical well-being to their spiritual recovery. Food is an important aspect of achieving the holistic healthcare the Centre strives to provide, and can often be the highlight of a patient's day.

A food delivery system should provide patients with nutritious and appealing meals without causing damage to buildings or injury to people. However, the Centre's effort to provide holistic healthcare, in part through state-of-the-art medical equipment and beautiful décor, is being undermined by the damage and safety concerns created by the Centre's food trolleys. Although many different food delivery systems exist around the world, the Queen Sirikit Centre has been unable to find one that works well within the hospital. Thus, the goal of our project was to provide recommendations for improving the food delivery system at the Queen Sirikit Centre for Breast Cancer. To accomplish this goal we completed the following objectives:

- 1) Conducted a needs assessment
- 2) Developed a design of a new food trolley
- 3) Provided suggestions for the manufacture and implementation of the new trolley

For a new food trolley to be integrated successfully into the Queen Sirikit Centre, the trolley operators, kitchen staff, and various levels of management would need to accept it. Throughout our work, we attempted to lay the groundwork for successful change implementation by using strategies suitable for the relationship-based organizations typical in Thailand. We regularly consulted the stakeholders to keep the lines of communication open and so that they would have a sense of ownership of the design and be more likely to accept it. We also involved high level, influential management within the organization to make some of the staff more likely to be open to the change.

In order to design a system that caters to the Centre's needs, we determined the expectations of our sponsor, the trolley operators, and kitchen management through semi-standardized interviews. To visualize the problems and learn more about the food delivery process in general, we conducted observational studies of the trolleys. We also obtained the results of a patient exit survey to gauge patient satisfaction with respect to food delivery. From this information, we determined the current trolley's shortcomings and the requirements of a new food trolley.

PROBLEMS WITH THE CENTRE'S CURRENT TROLLEYS

Based on the information gathered in our needs assessment, we analyzed the current food delivery system and reached the following determinations. A picture of the current trolley is shown in Figure 1.

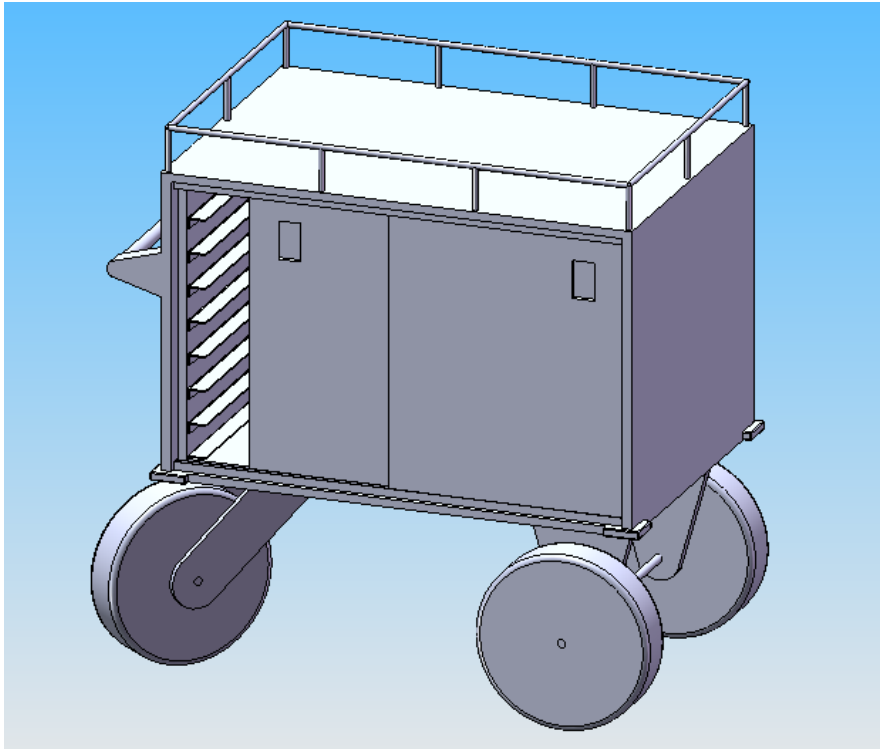


Figure 1: Model of the Centre's Currently Used Trolley

- **The trolleys are too heavy**
The current trolleys are difficult for the operators to push up the inclines around the hospital. The weight also makes the trolleys difficult to maneuver and slow to stop.
- **The wheel placement inhibits the operators**
The single wheel closest to the operator protrudes past the back of the trolley. Thus, the operators are forced to push the trolley from an awkward position, decreasing the trolley's maneuverability.
- **The trolleys are bulky and tall**
The current trolleys are very bulky which makes them difficult to maneuver in tight areas. They also severely limit the visibility of the operators because of their height.
- **The trolleys are a safety threat and are damaging the walls at the Centre**

Due to their large size and weight and poor maneuverability, the trolleys are a potential danger to the Centre's patients and staff. The trolleys are also damaging the walls near the elevators at the Centre.

- **The doors on the trolleys are difficult to open and close**

The current trolleys' doors slide open and closed, but they often get stuck which makes it difficult for the trolley operators to access the food.

- **The food packaging method creates a large amount of waste**

The current food delivery system uses a large quantity of cling wrap, which is not reusable or recyclable, to seal the food while it is being transported.

RECOMMENDED TROLLEY DESIGN

Based on our assessment of the Centre's needs and current trolleys, we recommend that the Queen Sirikit Centre adopt the trolley design with the following features. A model of the trolley design is shown in Figure 2.

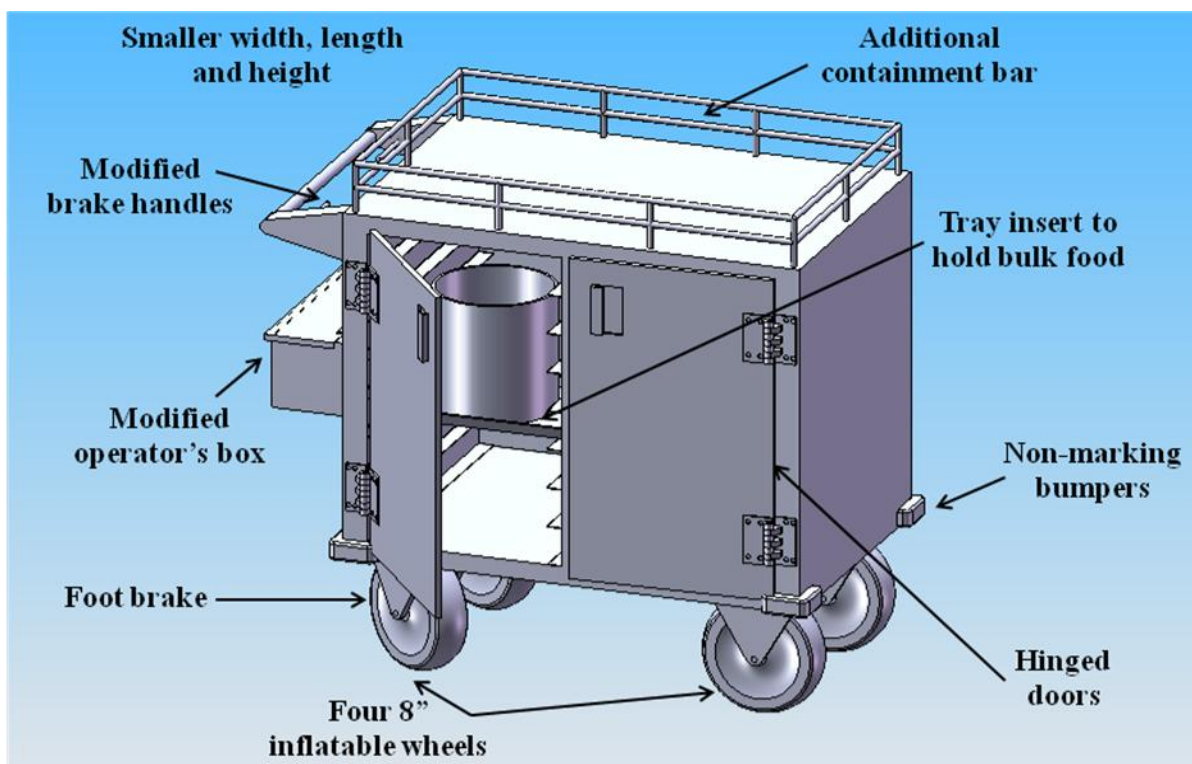


Figure 2: A Custom Design for the Queen Sirikit Centre Food Trolley

- **Four 20.3cm (8 in) inflatable wheels: two stationary opposite the handle bar and two that swivel under the handle bar**

These wheels should increase the stability and maneuverability of the trolley while still effectively traversing the uneven terrain between the kitchen and the Centre.

They will also decrease the height of the trolley to give the operators greater visibility.

- **A box fixed to the trolley to hold the operator's supplies**
This box will be capable of storing all of the operator's supplies.
- **A hand brake with the brake handle positioned in front of the trolley handle**
Hand brakes will increase the safety of the trolley by providing the operators with better stopping ability. The new handle positioning should also be more convenient for the operators to use than the brake handle on some of the current trolleys.
- **A foot brake to keep the trolley stationary**
The foot brake will increase the safety of the trolley by allowing the operators to lock the trolley in place when it is being loaded, unloaded, or is left unattended.
- **An insert that can be put inside the body of the trolley to support bulk food**
If the trolley body is not fully loaded, the insert will allow bulk food to be put inside the trolley to increase the operator's visibility.
- **A trolley body that is approximately 0.127 m³ (4.5 ft³) smaller than the current trolley body**
The smaller trolley will be able to contain 32 trays like the current trolley, but it will make the trolley easier to navigate in tight areas and decrease the weight by at least 7.5 kg (16.85 lbs).
- **Two hinged doors that open outward on both sides of the trolley**
These types of doors should give the operators easy access to the food and will also make the trolley easier to clean. The proposed doors will also lock so that they do not unintentionally open during transit.
- **Non-marking bumpers on each of the four bottom corners of the trolley**
These non-marking bumpers will help protect the walls at the Centre without leaving scuff marks.

ANCILLARY RECOMMENDATIONS

We also recommend that the Centre make modifications that would address some of the problems that cannot be addressed by the new food trolley alone, such as damage to the walls and environmental concerns.

- **Purchase and install corner guards to protect the walls near the elevators**
Although the bumpers will provide a buffer between the walls and corners of the trolley, it is possible that the sides of the trolley could rub up against a wall corner. Thus, we recommend that the Centre install corner guards on the walls near the elevators. We also recommend that the Centre purchase these corner guards from Phitphisarn. They can provide the guards in several colors, and the contact information for their sales office is shown in Appendix E.

- **Consult with kitchen staff and trolley operators regarding the impact of reusable containers**

Although we have located a company that produces sealable reusable containers, we are uncertain of their environmental impact or the effect they might have on the staff. Thus, we recommend the Centre conduct further studies before adopting the system.

RECOMMENDATIONS FOR MANUFACTURING AND IMPLEMENTATION

In order for the Centre to successfully manufacture and implement the proposed food trolley, we made the following recommendations:

- **Have the trolleys manufactured by Thai Trolley**

Thai Trolley is located just outside of Bangkok in Samutprakom. They provide reasonable prices, a one year warranty, and onsite maintenance. The trolley design can be manufactured by Thai Trolleys for 45,000 baht in twenty days or less.

- **Initially only purchase one trolley**

We recommend that the Centre conduct a trial with one trolley before making further purchases because adjustments might need to be made to the trolley.

- **Management should inform the operators that the Centre's trolleys are intended for and will hopefully be adopted by the entire hospital.**

The Centre's honorary advisor indicated that the trolley design might later be introduced to the entire hospital. Thus, we recommend that the trolleys be presented as a trial in order to minimize potential jealousy between the trolley operators.

- **Have upper management show their support for the new trolley through a brief statement and appearance when the trolleys are introduced**

Our research suggests that upper levels of management can have a large positive influence over the staff, even through limited involvement. Thus, we recommend that Dr. Kris Chatamra say a few words to the trolley operators in support of the new food trolleys.

- **Have lower levels of management discuss the different aspects of the new trolleys with the staff**

Because they have a closer relationship to the staff, the lower level managers should continue to communicate with the staff to obtain their opinions of the trolley. This feedback will help the management understand any problems during the trial period and help the change process go as smoothly as possible.

It is our hope that the food trolley we recommended for the Centre, if adopted, will have substantial benefits for the safety of the hospital visitors, health and well-being of the trolley operators, and the upkeep and aesthetics of the Centre.

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1.0 Introduction

Breast cancer is the most common cancer among women in Thailand (Attasara & Buasom, 2007). The Queen Sirikit Centre for Breast Cancer, a public teaching hospital located in Bangkok, works to address this problem by treating any patient with breast cancer regardless of his or her financial status. In order to treat as many women with cancer as possible, the Centre conducts outreach programs to find underprivileged women to be screened for cancer. The Centre strives to go beyond treating the cancer, and endeavors to care for every patient as a whole, spanning from his or her physical well-being to his or her spiritual recovery. To do this, the Centre has obtained the most advanced medical technology and maintains a pleasant atmosphere to aid relaxation and healing.

Food is an important aspect to achieving this holistic healthcare and can often be the highlight of a patient's day. A food delivery system should provide patients with nutritious and appealing meals without causing injury or damage to the surrounding people or buildings. However, the food trolleys which are currently used to deliver food at the Centre compromise the safety of both hospital staff and patients due to their limited maneuverability, heavy weight, and large size. In addition, the trolleys damage the building, compromising the aesthetic qualities of the Centre and leading to the need for repairs in a public hospital with limited funding.

Although many different food delivery systems exist around the world, the Queen Sirikit Centre has not found one which works well within the hospital. Due the Centre's unique situation of budget constraints and separate buildings, the trolleys have to be able to transport large amounts of food over a variety of gradients both indoors and outdoors. The Centre is in need of a new delivery system that accomplishes this task while also accounting for the specific needs of its patients, staff, and management.

The goal of our project was to provide recommendations for improving the food delivery system at the Queen Sirikit Centre for Breast Cancer. To accomplish this goal we completed the following objectives:

- 1.) Conducted a needs assessment
- 2.) Developed a design of a new food trolley
- 3.) Provided suggestions for manufacture and implementation of the new trolley

Through the needs assessment we characterized the current state of the food delivery process at the hospital as well as the expectations of the hospital's patients, staff, and management using interviews, observational studies and a patient questionnaire. We used this information to develop a new food trolley design and regularly asked for the staff's input to ensure the trolley met the requirements of the Centre. Via interviews in the Centre and follow-up research, we gained contact information to a manufacturer that could fabricate the custom design quickly for a reasonable price. Throughout our time at the hospital, we observed common methods of implementing change, and used this knowledge to suggest how the new system could be implemented. By employing these methods, we provided the Queen Sirikit Centre for Breast Cancer with a design for a food trolley that meets their needs and contact information for a company that can manufacture it.

2.0 Background

The Queen Sirikit Centre for Breast Cancer is in need of a food delivery system that meets the expectations of their patients, food service staff, and management. However, introducing something new into an existing work environment can be problematic. In order for the new food delivery system to be successful, staff at all levels of the hospital need to accept the process. Thus, it is important that we understand not only the food delivery process, but also Thai culture and the effect it has on the manner in which Thai people interact in various work situations. This Background chapter will focus on providing a basis for understanding the Queen Sirikit Centre for Breast Cancer, food delivery systems, and how change is implemented within Thai organizations.

2.1 The Vision and Challenges of the Queen Sirikit Centre for Breast Cancer

The Queen Sirikit Centre for Breast Cancer is a branch of the King Chulalongkorn Memorial Hospital. The Centre was founded by Dr. Kris Chatamra, an oncologist at the King Chulalongkorn Memorial Hospital. Dr. Kris and his wife, Khunying Finola Chatamra, began the Centre with the mission to provide the best possible care with the most recent technology to anyone in need, regardless of financial status (Queen Sirikit Centre, n. d.). A picture of the Centre is shown in Figure 3. It was opened on June 11, 2005 and is located in the center of Bangkok on the edge of the main hospital campus. The Centre is a teaching hospital that employs 25 professional staff and contains 80 patient beds which are usually all in use. Breast cancer is the primary focus of the facility, but it is a public hospital open to treating any cancer in women, men or children (F. Chatamra, personal communication, January 13, 2009).



Figure 3: Queen Sirikit Centre for Breast Cancer
<http://www.queensirikitcentreforbreastcancer.com/index.php>

Although the Centre strives to provide the best healthcare possible, its finances are strained. Public hospitals in Bangkok, such as the King Chulalongkorn Memorial Hospital, are dealing with an increased demand for care and decreased funding (Valdmanis, Kumanarayake, & Lertiendumrong, 2004; Towse, Mills, & Tangcharoensathien, 2004; Nittayaramphong & Tangcharoensathien, 1994). Due to this limited funding, the King Chulalongkorn Hospital does not help fund the Centre beyond paying for the doctor's salaries and basic utilities. Thus, donations are the Queen Sirikit Centre's primary income source. Her Majesty the Queen donated 2 million baht (approximately 57,000 U.S. dollars) to start the Centre. Today, most of the funds generated are donations garnered by the Centre's administration. According to Khunying Finola, the Honorary Advisor to the Centre who works to raise funds for the facility, approximately 700 million baht (about 20 million U.S. dollars) have been collected to ensure that the facility has the most recent equipment and technology. The Financial Board of the Thai Red Cross Society also provides some assistance in funding the Centre.

The Centre is involved with many initiatives to educate people about breast cancer, treat every woman in need, and provide the best care possible. Currently, 90% of the women treated at the Centre are underprivileged. The Centre conducts outreach programs to twelve slums in Bangkok where representatives of the Centre encourage every woman over forty to come to the hospital to be screened for cancer (F. Chatamra, personal communication, January 13, 2009). Every patient receives customized healthcare, in part because the Centre has structured itself to facilitate interdepartmental communication and collaboration. Meetings are held with all the doctors and anyone involved in the patient's healthcare to discuss the best course of action for each individual patient. As Khunying Finola suggests, the process is similar to a doughnut in which the patient is the center, and the doctors and staff fill in a circle around him or her to provide the customized healthcare (F. Chatamra, personal communication, January 13, 2009).

Another aspect of providing excellent healthcare is the continuing education of the medical staff. As part of this initiative, the Centre pays for their doctors to travel to the United Kingdom to earn their doctorates. While there, they also work to improve their English, enabling them to travel to conferences worldwide so they can be knowledgeable about the most recent and advanced medical techniques. In addition, the Centre is doing research to develop a method of using a woman's own stem cells to preserve her breast after

surgery, as losing a breast can be a very traumatic event in a woman's life (F. Chatamra, personal communication, January 13, 2009).

Because healthcare does not end with surgery, the Centre places emphasis on the environment the facility creates. The Centre's walls are calming colors, and many of the photographs within the hospital depict plants to encourage the patients to think about continuing life. An example of a wall at the Centre can be seen in Figure 4. Nearly all the decorations in the Centre were donated, and throughout the hospital are displays of beautiful silk and insightful artwork. By giving the patients a friendly, calming space in which to heal, the Centre strives to make the experience of fighting cancer less terrifying (F. Chatamra, Personal Communication, January 13, 2009).



Figure 4: An Example of the Decorations around the Centre

Part of creating an environment where patients can heal is being able to provide for their daily needs, such as food. To accomplish this task, the Queen Sirikit Centre relies on the King Chulalongkorn Memorial Hospital's kitchen and food delivery staff. The kitchens are in a separate building from the Centre, and the food trolley that transports the meals must travel outside over uneven ground and up and down inclines in order to get to the Centre. Although the food trolleys are capable of transporting all of the necessary food, they are a safety concern for the patients and staff and damage the building. The Centre attempted to address this issue by trying a pre-made food trolley manufactured by Driessen, a German trolley company, but Khunying Finola reported that the kitchen staff was not satisfied with the trolley's wheels. Thus, the trolley was not adopted, and the manufacturer did not follow up to make it more suitable for the Centre (F. Chatamra, personal communication, January 13, 2009). Our team was recruited to conduct a more thorough investigation of trolley design options and recommend a trolley that would meet the Centre's needs.

2.2 Food Delivery Systems

In this section we begin by summarizing key requirements of hospital food delivery systems, including food safety, nutritional value, and appeal to patients. We will then introduce two of the major types of food delivery systems: plated meal systems and cafeteria style systems. Aspects of both systems are used at the Queen Sirikit Centre.

2.2.1 Requirements of Food Delivery Systems

Food delivery systems should carry out several functions beyond transporting meals. Food safety is a very important aspect of the food preparation process, of which delivery is the final step. There are several different approaches to ensuring the food does not spoil while it is being delivered to the patients. The food can either be stored above a certain temperature (commonly referred to as hot holding), below a certain temperature and then reheated (commonly referred to as cook/chill), or held at an unregulated temperature for a limited period of time (United States Food and Drug Administration [FDA], 2006). Our search of information written in English revealed no laws regulating food holding temperatures in Thailand, and the kitchen supervisors at the Queen Sirikit Centre were also not aware of any regulations. Thus, to gain perspective of food safety practices, we referenced the codes developed by the United States Food and Drug Administration, the department responsible for legislation regarding food safety in the United States. These standards state that as long as cooked food starts with an initial temperature of 57 °C or greater, it is safe to eat for up to four hours, regardless of the temperature at which it is stored (FDA, 2006). Thus, according to these standards, as long as the food delivery system delivers the food so that the patients consume it within four hours of it being cooked, the safety of the food will be maintained.

In addition to maintaining the safety of the food, the food delivery system should preserve the nutritional value of the food. However, preventing nutritional loss can be difficult because the processes used to keep food safe can easily destroy the vitamins in the food. Research has shown both the hot holding and the cook/chill method decrease the nutritional value of the food because vitamins are lost when food is kept at extreme temperatures, which happens when food is frozen or hot held. Vitamins are also destroyed when the food goes through rapid temperature changes which occur during chilling and reheating (Feldman et al., 2006; Williams, 1996). Food delivery systems should work in such a way that the food's safety is maintained without a significant loss of nutrients.

Safe and nutritious food is only beneficial if the patients consume it. Thus, in order to increase the likelihood that patients eat the food delivered to them, it should be appealing. Some of the factors which determine appeal are taste, smell, texture, temperature, and dishware. Although these factors are largely influenced by the manner in which the food is prepared and cooked, the food delivery system impacts the texture and temperature of the food as well as the dishware used. Research has shown that hospital patients in Western cultures deem temperature to be the most important aspect to food appeal (Stanga et al., 2003). Westerners generally prefer their ‘hot’ food to be served hot instead of warm or at room temperature, so many food trolleys in Western countries are insulated or heated. We could not find any studies of food temperature preferences of Thai people, but we did observe that room temperature food seems common. To determine if the food served at the Centre meets the desires of the patients, we researched patient satisfaction at the King Chulalongkorn Memorial Hospital as part of our methodology.

2.2.2 Plated Meal System

Many different food delivery systems can meet the requirements for food safety, nutritional value, and patient satisfaction. One common system is the plated meal system, which has the following steps: the patients order the food, the kitchen staff prepare the food and dish it into individual servings, the trolley operators transport the servings to the patient wards, and the nurses serve the food to the patients (Hartwell & Edwards, 2001). A flowchart of the steps in the plated meal delivery process is shown in Figure 5. The key feature that defines the plated meal system is that the food is transported *after* it is divided into individual meals. .



Figure 5: Flowchart of Plated Meal System

There are several types of trolleys which can be used in the plated meal system. The first type is very basic and consists of runners to support the trays (S. Croteau, personal communication, November 24, 2008). A picture of this type of trolley is shown in Figure 6. Another type of trolley is similar to the first because it has runners, but it also encloses the

trays (Hartwell & Edwards, 2001). These enclosed trolleys can have insulation or use electrical power to heat the inside of the trolley. An example of an enclosed trolley can be seen in Figure 7.



Figure 6: Basic Food Trolley

<http://www.ferret.com.au/odin/images/160497/Breakfast-trolley-to-accommodate-breakfast-food-trays-available-from-Spacepac-Industries-160497.jpg>



Figure 7: Enclosed Food Trolley

<http://www.ferret.com.au/odin/images/172877/Food-trolley-172877.jpg>

2.2.3 Cafeteria Trolley System

The cafeteria trolley system is another type of delivery method which is used by the Queen Sirikit Centre. The process consists of the kitchen preparing the food, and then the trolley operators transporting the food to the patient wards in large serving containers where it is plated and served to the patients. A flowchart of the steps in the cafeteria trolley delivery system is shown in Figure 8. The key feature which defines this process is that the food is transported in large bulk containers rather than individual servings.



Figure 8: Flowchart of Cafeteria Trolley System

Food trolleys used in the cafeteria trolley delivery process are fairly similar to those used in the plated meal system. However, trolleys which are used solely for the cafeteria trolley system are configured such that they only transport large containers of food. Some trolleys used in Western countries are heated so that they can keep the food at hot temperatures for an extended period (E. Taglieri, personal communication, November 29, 2008). An example of a heated cafeteria trolley can be seen in Figure 9.



Figure 9: Trolley Used for Cafeteria Trolley System

<http://www.shortorder.com/files/images/products/0000/3006/AltoSham750-CTUS.jpg>

2.2.4 The Centre's Food Delivery System

The Queen Sirikit Centre uses both the plated and cafeteria trolley systems to deliver food to patients and staff at the hospital. They use the plated meal method to deliver food to patients because it allows the patients some degree of freedom in choosing their food. However, the plated meal system is less efficient and thus more expensive than the cafeteria trolley system. Therefore, the plated meal system is only used for patients who pay more, and the rest of the meals are delivered using the cafeteria trolley method.

The type of food trolley the Centre uses is capable of accommodating both the plated meal and cafeteria trolley delivery systems. The inside of the body, which is not heated or insulated, has slots that hold 32 trays with plated meals. Figure 10 is a picture of the food

trolley and Figure 11 is a picture of plated meals inside the body of the trolley. The top of the trolley can be used to hold several large containers of bulk food as well as a stack of empty trays and meals for patients on liquid diets. A picture of these items being transported on the top of the trolley is shown in Figure 12. The trolley's ability to use both food delivery methods allows the Centre to transport food for all patients and staff using one type of trolley.



Figure 10: Food Trolley Used at the Queen Sirikit Centre



Figure 11: Plated Meals Inside the Trolley



Figure 12: Top of the Trolley Holding Bulk Meals, Trays, and Liquid Food

2.3. Implementing Changes within the Queen Sirikit Centre

A food delivery system that is not accepted by the people who need to use it would not be an improved system for the Centre. In her early interactions with the kitchen staff and trolley operators, Khunying Finola sensed that there might be some resistance to change (F. Chatamra, personal communication, January 13, 2009). This section will discuss the organizational structure of the Queen Sirikit Centre for Breast Cancer, the preferred methods of implementing change by other Thai organizations, employees' typical reactions to change, and suggestions for how to successfully integrate a new idea into an existing system.

2.3.1 Organizational Structure and Culture of the Queen Sirikit Centre

In order to understand how change would take place within the Queen Sirikit Centre for Breast Cancer, we looked at the Centre's organizational structure. Experts agree that most business structures in Thailand mirror a family environment in which the superiors act as parents to their subordinates (Lawler, Jain, Ratnam & Atmiyanandana, 1995; Niffenegger, Kulviwat & Engchanil, 2006). While our observations at the Centre were somewhat limited due to both time constraints and language differences, we did detect several examples that indicated the Centre's organizational structure most likely reflects many of the norms discussed by scholars of organizations in Thailand. Within the Centre's system is a complex organizational structure with social norms explained by underlying cultural values.

During our limited time at the Centre, we observed an atmosphere that appears to embrace values Niffenegger et al. describe as more feminine. Feminine values are typically exhibited by most Thai people, and are seen as warm and are generally evidenced by understanding the plights of others and worrying about how others feel (Niffenegger, et al., 2006). We have seen these feminine values illustrated in the Queen Sirikit Centre through management's respect for their workers and concern about the physical well being of the trolley operators.

Management's concerns also illustrate a strong interdependence among workers in the Centre. As seen in Figure 13, according to experts on culture and business, most Thai people do not typically rank individualism as a strong work value. Instead, many Thai people generally attach importance to people's abilities to work well with each other (Niffenegger, et al., 2006). Interdependence also corresponds with another value, Confucian dynamism, which experts state is exhibited by many Thai people. Confucian dynamism is defined as the emphasis on the long term relationship versus the short term gain (Lawler, et al., 1995; Niffenegger, et al., 2006). Most Thai people's tendency to try to avoid conflict and situations which could be traumatic or discomfoting is likely due in part to these values (Niffenegger, et al., 2006).

According to Niffenegger et al. and Lawler et al., there is typically a fairly rigid hierarchal structure in Thai businesses which is part of Thai people's strong interdependence. In general, the lower levels are expected to perform services for the higher levels, which in turn have the responsibility to look after the lower levels. This corresponds with the Buddhist principle of placing the needs of others before oneself (Lawler, et al., 1995; Niffenegger, et al., 2006). At the Centre, there are clearly defined levels of staff which range from general staff, such as the trolley operators, to Dr. Kris, the director of the Centre. According to our limited experiences at the Centre, it appears that the staff we observed respect each other, as is evidenced in the generous and humble manner they show towards each other. However, from our observations, it seems that the upper levels of management tend to make decisions which general staff obey. A fairly rigid hierarchy and the principles of placing another's needs before one's self both appear to be exhibited at the Queen Sirikit Centre for Breast Cancer.

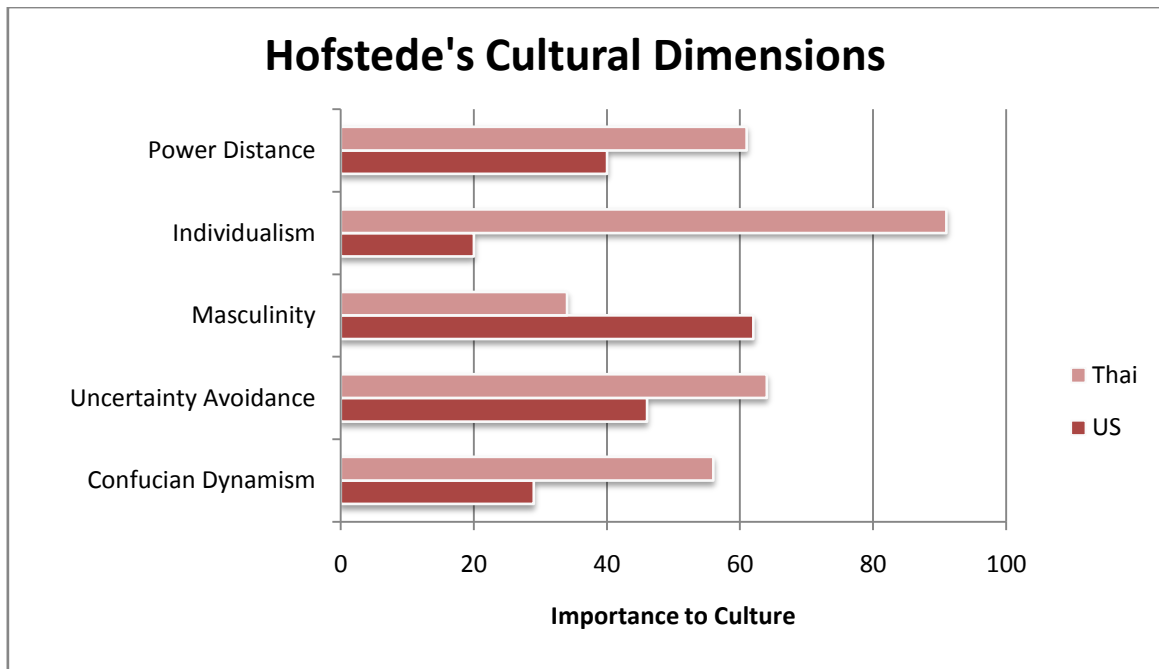


Figure 13: Comparison of U.S. and Thai Cultural Values
(Niffenegger, Kulviwat & Engchanil, 2006)

2.3.2 Methods of Change Preferred by Thai Managers

A plan for implementing change is likely to be more successful if it utilizes strategies consistent with the Centre's cultural and organizational values. Based on research into the Thai cultural values and influence strategies, it appears as though Thai managers most commonly prefer an influence strategy which Fu et al. refer to as relationship-based. This strategy is defined by a person utilizing a strong personal relationship with someone to achieve a desired outcome and can include: gift giving, engaging in interactions outside of work, asking for personal favors, socializing about non-work related matters, and bargaining (Fu et al., 2004). This preference for "relationship-based" persuasion stems in part from three of Thailand's national cultural values: collectivism, uncertainty avoidance, and long-term orientation (Klausner, 1993; Niffenegger, et al., 2006). According to an international study conducted to explore the relationship between cultural values and the perceived effectiveness of influence strategies, there is evidence that suggests each of these three values individually leads to a more prevalent preference for relationship-based influence strategies (Fu et al., 2004; Fu & Yukl, 2000). Figure 14 is a model which illustrates these national cultural values and relates them to influence strategies. Only the relationship based strategy relates to all three cultural values. The existence of these values in Thai culture helps to explain the Thai managers' common preference for the relationship based strategy.

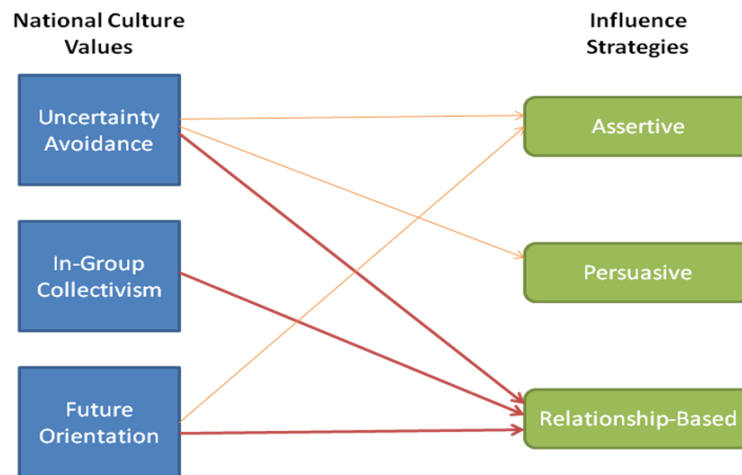


Figure 14: Relationships Between National Culture Values and Influence Strategies
(Fu et al., 2004)

2.3.3 Thai Peoples' Response to Change

A process of implementing change is likely to be more successful if it acknowledges how Thai people generally react to change and utilizes strategies that Thai businesses typically use to bring about change. One factor which plays a large part in people's reactions to change is their personality. Cawsey and Deszca, experts on organizational change, explain that someone who does not cope well with uncertainty does not typically tolerate change well (Cawsey, T. F., & Deszca, G., 2007). Several experts agree that Thai people typically exhibit uncertainty avoidance and find comfort in a clearly defined status within a predominantly stable structure, and thus generally do not tolerate change well (Cawsey, T. F., & Deszca, G., 2007; Klausner, 1993; Niffenegger, et al., 2006). Although most Thai people may typically be apprehensive towards change, Cawsey and Deszca explain that people's reactions depend mostly on what impact they believe the change will have on them (Cawsey, T. F., & Deszca, G., 2007). According to an article about Thailand in the journal, *Economist*, the most frequent reasons Thai people resist change is fear that their relationships will be disturbed and fear that they will lose their power or status (Economist, 1997). From this publication, it would appear that some Thai people may have fewer reservations about the change if they think the change will have a minimal effect on them.

Although inferences can be made about the implications of implementing change within the Thai context, there are still universalities of implementing change. Cawsey and Deszca state that in general, problems with change are due to mistakes in the implementation process rather than individual resistance. The reasons they claim generally cause negative

reactions to change are shown in Table 1. Many of the problems Cawsey and Deszca outline result from the new plan being poorly researched, underdeveloped or unjust. However, they recognize that past experiences, reactions of others, and inadequate communication can also lead to negative reactions (Cawsey, T. F., & Deszca, G., 2007).

TABLE 1: CAUSES OF NEGATIVE REACTIONS TO CHANGE
(Cawsey, T. F., & Deszca, G., 2007, 212)

- 1. Negative consequences clearly outweigh the benefits.**
- 2. The communication process is flawed, leading to confusion and doubt.**
- 3. There is concern that the change has been ill conceived, insufficiently tested, or may have adverse consequences that are not anticipated.**
- 4. The recipients lack experience with change and its implications, or have habituated approaches that they rely on and remain committed to.**
- 5. The recipients have had prior negative experience with a similar change.**
- 6. The recipients have had prior negative experience with those advocating the change.**
- 7. The negative reactions of peers, subordinates, and/or supervisors whom you trust and respect and with whom you will have to work in the future influence your views.**
- 8. The change process is seen to be lacking procedural justice and/or distributive justice.**

2.3.4 Effective Ways of Implementing Change

Although many Thai people are likely to resist change, there are general guidelines that can be followed to make an organizational transition go smoothly. Cawsey and Deszca warn that people implementing change should avoid coercion if possible (Cawsey, T. F., & Deszca, G., 2007). Successful change involves guiding the process and providing the people it affects with the necessary information so that they can make an informed decision.

As Cawsey and Deszca explain, the change process can be thought of in terms of three distinct phases. There is the unfreezing period, the change phase, and the refreeze. It is generally regarded that the change phase is the most pivotal period in implementing change because people are typically still trying to understand the change and have not yet formed any explicit conclusions. During this time, people may have doubts, but their feelings will not yet have developed into a resolved cynicism. Cawsey and Deszca also claim that once people

have developed opinions about the change, they are very unlikely to alter their views. Thus, they explain that it is beneficial for the people implementing the change to help the people affected appreciate its positive aspects before their beliefs are solidified (Cawsey, T. F., & Deszca, G., 2007).

Ideally, all people would immediately accept the change, but it is likely that some people will have doubts. According to Cawsey and Deszca, there are several techniques which can be used to help ensure that these doubts do not turn into contempt. A list of techniques to help manage and minimize cynicism towards change is shown in Table 2. These mainly deal with prompting open discussion and keeping the people affected by the change informed about it. Experts explain that being honest with people, admitting mistakes, and making corrections as necessary also help to facilitate the integration of a new idea.

TABLE 2: WAYS TO MINIMIZE CYNICISM ABOUT CHANGE
(Cawsey, T. F., & Deszca, G., 2007, 225)

1. **Keep people involved in making decisions that affect them.**
2. **Emphasize and reward supervisors who foster two-way communications, good working relationships, and show consideration and respect for employees.**
3. **Keep people informed about ongoing change: when, why, and how; and include honest appraisals of risks, costs, benefits, and consequences.**
4. **Keep surprises to a minimum through regular communications about changes, anticipating questions and concerns.**
5. **Enhance Credibility by:**
 - a. **Using credible spokespersons that are liked and trusted.**
 - b. **Using positive messages that appeal to logic and consistency.**
 - c. **Using multiple channels and repetition.**
6. **Acknowledge mistakes, accept responsibility, apologize, and make amends.**
7. **Publicize successful changes and progress.**
8. **Use two-way communications in order to see change from employees' perspective, and use this awareness to help with planning future communications related to change.**
9. **Provide opportunities for employees to express feelings and to receive validation and reassurance. Ensure you address the concerns raised.**

Along with their recommendations of opening lines of communication and being honest, Cawsey and Deszca discuss that it is beneficial to have key people accept and promote the change. They explain that a trusted colleague who has a positive perspective of the change can make some people much more open to accepting it (Cawsey, T. F., & Deszca, G., 2007). Thus, it can be very beneficial to the successful implementation of the change if highly trusted individuals support it. Because the Centre uses a hierarchal structure, it is particularly important to have people's superiors support the change. As Klausner observes, typically, most Thai employees trust their supervisors, and most believe that many supervisors have the worker's best interest in mind (Klausner, 1993). Therefore, many workers are likely to agree with their supervisor's beliefs. Based on this research and early observations of the Centre, we utilized the change strategies for relationship based work environments highlighted by Cawsey and Deszca to begin assessing the needs of the Centre and preparing the employees for the possible change to the existing food delivery system.

3.0 Methodology

Our goal was to provide recommendations for the improvement of the food delivery system at the Queen Sirikit Centre for Breast Cancer. To achieve this goal, we completed three objectives. We conducted a needs assessment to determine what the patients, staff, and management in the hospital required of a trolley. We then used this information to develop a trolley design that met the requirements of the Centre. We also provided recommendations for manufacturing and implementing the trolley so the Centre will be able to utilize the design.

We aimed to lay the groundwork for a smooth transition from the old system to a new system. Recognizing that changes would have to be made in order for the system to improve and that challenges with introducing change are inevitable, we began using tactics to ease the implementation process simultaneously with the needs assessment. We regularly asked for opinions and feedback from the stakeholders at the Centre because we wanted them to have a sense of ownership of the new design. According to best practices in change implementation, it is beneficial to keep the lines of communication open and keep staff informed at all times (Cawsey, T. F., & Deszca, G., 2007). We also looked to understand relationships between management and staff because our research indicated that Thai businesses tend to operate on a relationship based work environment, and we wanted to develop recommendations which were pertinent to the culture at the Centre. In this portion of our report, we will discuss how we developed a new trolley that the Centre could implement.

3.1 Conduct a Needs Assessment

There is no one food delivery system that could address the needs of all the institutions requiring one. In order to understand the nature of the Centre's problems and design a system that catered to their needs, we researched various aspects of food delivery at the Centre. We structured this research around the following research questions:

- **How does the Centre's food delivery system operate?**
- **What are the management's requirements for a food delivery system?**
- **What are the trolley operator's requirements for a food delivery system?**
- **What are the patient's requirements for a food delivery system?**

- **Does the Centre’s current trolley meet these requirements?**
- **What aspects of the process are not feasible to change?**

We utilized a combination of semi-standardized interviews and observational studies to obtain this information. The semi-standardized interviews allowed us to gather general information on the existing food delivery process while still allowing each stakeholder the flexibility to explain and elaborate on their various thoughts and concerns (Berg, 2007). Additionally, we obtained general information on the existing food delivery process through these interviews. Because there was a language barrier between ourselves and the Centre’s Staff, we conducted observational studies to help us understand the delivery process and ensure we discovered any obvious problems. The interview and observational study protocols are shown in Appendix A.

To understand the background of the Centre and the current food delivery system, we interviewed Khunying Finola Chatamra, the Honorary Advisor to the Centre, who originally asked us to address the problems with the food trolleys. The interview lasted about thirty minutes and was conducted as a forum in which two students prompted discussion and follow up questions while the third took notes.

We interviewed the trolley operators, kitchen director, and dieticians with group semi-standardized interviews to obtain information about both positive and negative aspects of the current system, patient satisfaction, and the general food delivery process. The interviews lasted about thirty minutes, and Khunying Finola, who is fluent in Thai and English, served as a translator. However, it is possible that there were small misinterpretations and misunderstandings through the translation. Due to the limited time both the operators and translator had available to spend with us, individual interviews were not feasible. The group interviews may have limited the content of the feedback. Some operators may have been hesitant to share certain feelings, or others may have monopolized the conversation. However, because all individuals in the group interviews stated opinions, we do not believe the group format was problematic. In both interviews, one team member primarily asked questions, and the other mainly took notes and asked questions to verify points. The specific limitations and details of each interview are discussed in the two paragraphs that follow.

One interview was conducted with the director of the kitchen and two dieticians. Although they were generally knowledgeable about the system and its shortcomings, it appeared as though they would reply “no” rather than express uncertainty when they did not

understand a question. When we rephrased these questions, they would sometimes reply with an affirmative response and show us evidence to support it. To increase the managers' understanding and obtain the most pertinent information, we asked the questions in several different manners.

During the interview with three trolley operators out of approximately fifty operators who work at the hospital, we solicited their feedback. Because of the limited time with a translator and the busy schedules of the operators, we were unable to interview more operators. However, the opinions of the three operators were very similar, and some of the operators alluded to what they'd heard from other operators. Thus, we feel that the feedback from the three operators was a reasonable representation of the general opinions of most of the operators, but recognize that the feedback may have been incomplete. We asked them questions while standing around a trolley so that the women could point to the various parts they were describing. Two of our team members took notes and asked questions, and the third took pictures of the trolley. Our research into Thai culture led us to believe that the trolley operators might not be as open or forthcoming with us while discussing the negative aspects of the trolley. However, the operators were informative and appeared to be very honest with us. We suspect this was partially a result of Dr. Kris Chatamra, the director of the Queen Sirikit Centre, speaking with the operators before the interview to explain our purpose and to encourage them to be open with us. The influence this short appearance seemed to have with the trolley operators corresponds with our research that suggests most Thai staff tend to trust their superiors (Klausner, 1993).

We also completed two observational studies in order to verify the problems and opinions discussed in the interviews and to gather more general information about the food delivery process. We followed two different trolleys, and management accompanied us to translate if necessary. Both trolleys delivered lunch; one delivered food to the Centre, and the other delivered food to another building at the hospital. Two team members took notes, and one documented the study with pictures. A standardized evaluation sheet was used to document the operator's interactions with the trolley, the trolley's function and path, and the overall food delivery system; this evaluation sheet can be seen in Appendix A. After the study, two students took measurements of the dimensions of the trolley. Although we tried to interfere as little as possible while observing the operator, we recognize that the trolley operator may have acted differently because both we and the management were watching.

In order to solicit the opinions of the patients, we planned to conduct a survey regarding food temperature. However, we obtained the results of a survey given to all patients when they leave the King Chulalongkorn Memorial Hospital, of which the Centre is a part. The data included patient opinions of the overall temperature, crockery, and texture of the food, which are all impacted by the food delivery system. Although the survey was not Centre specific, we determined that it still contained relevant information about the food delivery system because the food delivery process to all different areas of the hospital is similar. The exit survey also gathered data from a larger sample group than our survey would have and was distributed during a three month period to all patients at their time of discharge, so the results were less biased by a particular meal than ours would have been. Although we were unable to determine the exact response rate of the survey, we concluded that it was accurate enough for our needs, and the benefits of using the existing data were greater than the benefits of conducting our own survey.

3.2 Design Process

Using the information gathered in our needs assessment, we completed our second objective: designing a new food trolley. To develop designs we applied techniques from two well regarded design processes (Dym & Little, 2004; Volland, 2004). The specific design process we developed and followed was guided by the following research questions:

- **What are the objectives that the design needs to accomplish?**
- **What are the functions the trolley needs to perform?**
- **What are the constraints of the new trolley?**
- **What are possible trolley designs?**
- **What are the successes and challenges of other existing food delivery systems in hospitals in Thailand?**
- **What trolley design will best accomplish the objectives we determined?**

The first three research questions were aimed at understanding the nature of the specific problem and were answered in the problem formulation phase of our design process. In the idea generation portion of the design process, we determined what some possible trolley designs were and learned more about food delivery systems at other hospitals in

Bangkok. In the analysis phase we determined which designs would be best for the Centre based on the extent to which they accomplished the design objectives, and the respective importance of these objectives. In the detailed design phase, we made necessary adjustments and finalized the design.

3.2.1 Problem Formulation

In the initial phase of the design process we focused on taking the data gathered in the needs assessment and formalizing it into an outline that could be used to develop food trolley designs. We developed this outline through analyzing the root cause of problems with the current trolley and determining the objectives, functions, and constraints of the new trolley:

- **Root Cause Analysis:** We constructed why-why diagrams (Volland, 2004), which are a particular technique for identifying the sources of problems. An example of this process is: *why* does the trolley damage the walls → because it is hard to maneuver → *why* is the trolley hard to maneuver. This would continue until the problem had been explored to an adequate depth.
- **Functions:** Functions are the tasks that a design must carry out and are measurable in absolutes; an example of a function for a trolley would be “needs to hold all necessary food.” If a trolley design did not accomplish this, we would not consider it.
- **Objectives:** Objectives are the stakeholders’ goals for a design. Objectives state what should be done but do not confine the designer by specifying how. An example of an objective for a trolley might be “easy to clean,” and can be satisfied in different ways and to different degrees.
- **Specifications:** Specifications are measurable limitations of a design. An example would be that a trolley could not be any wider than 110cm. This could be determined by knowing that the trolley must fit into a space that is 110cm wide.

To aid our development of objectives, we constructed an objective tree which helped us visualize how the higher order objectives can be broken down into smaller goals. A more detailed explanation of objective trees and why-why diagrams can be found in Appendix B. One limitation of these lists and diagrams is that they have the potential to be a biased representation of the beliefs of those who construct them. In order to counteract this tendency, we discussed the objectives and functions we determined with the kitchen

management and trolley operators to solicit their opinions and feedback. They were able to provide input about the design without being familiar with the design process, and we hoped this involvement would give them a greater sense of ownership of the design to make the final implementation smoother. The root cause analysis, objectives, functions, and specifications provided the basic structure we used to develop trolley designs.

3.2.2 Idea Generation

In this portion of the design process, we developed possible trolley designs. We drew ideas from the needs assessment, other food delivery systems in Bangkok, existing food trolleys that could be purchased, and our engineering knowledge. We also used several idea generating tactics which included creating sketches and charts.

To help us begin generating ideas for the food delivery system at the Centre, we conducted semi-standardized interviews at Bangkok Nursing Home and Bumrungrad Hospital. Two group members asked questions and took notes, while the third person took pictures. These interviews lasted about twenty minutes, and focused on the type of food delivery system in each hospital as well as the problems and successes they were experiencing with their respective systems. None of the interviewees spoke English as a first language, so there may have been some misunderstandings. However, we conducted the interviews in the kitchens where either party could point at the trolleys in order to aid the discussion. Although we suspected that some of the staff might have been hesitant to share their food trolley's shortcomings with people not involved in their facility or may have tried to over exaggerate the successes of their systems, both interviewees appeared to be open about both the strengths and weaknesses of their delivery systems.

We also researched trolleys and other products that could be beneficial to the Centre or provide us with useful ideas. We researched different food trolleys that were available for purchase to see if they fit the needs of the Centre or could be slightly modified to do so. We also looked at other products which required similar functions to the trolley such as bicycles and airport trolleys for their braking systems.

Because the food trolley needed to perform many loosely related functions, we broke the problem into those separate functions and addressed them individually with specific feature designs. To facilitate this process, we organized our ideas in a table known as a morphological chart which displayed the different functions and possible means of

accomplishing them through the different features of the trolley. To learn more about constructing a morphological chart and the brainstorming methods we used, see Appendix B.

3.2.3 Analysis

In the analysis portion of our design process, we determined which feature designs best met the needs of the Centre and combined them to formulate complete trolley designs. To evaluate our feature designs in as unbiased a manner as possible, we analyzed them based on the objectives we determined in the problem formulation phase. While we were analyzing the designs, we considered each objective's importance to the stakeholders so that we did not give unwarranted influence to any objective. Once we had determined which designs we believed would be the best features for the Centre, we showed the trolley operators and kitchen management these designs and asked for their input to ensure that our interpretation of their needs was correct. We further hoped to again provide them with a sense of ownership of the trolley to make the implementation process smoother. Using their input, we refined the individual designs and then combined them into two complete trolley designs.

3.2.4 Detailed Design

In the detailed design phase, we continued to develop and refine the most promising designs. Because we did not have the time or resources to construct prototypes, we chose to develop computer drawings of the designs using drafting software. Once we had developed drawings of our designs, we brought them to the stakeholders so that they could have a visual representation from which to provide feedback. The final drawings can be used to communicate the designs to stakeholders, manufacturers, and potential donors.

3.3 Develop Recommendations for Manufacturing the Food Trolley

The final objective of our project was to provide recommendations for manufacturing the food trolley to transform the new design into a working trolley. The research questions which guided our efforts to locate a suitable manufacturer were as follows:

- **What are the manufacturers in the Bangkok area that would be able to manufacture a custom trolley?**
- **How much would manufacturing, modifying or buying the trolley cost?**

- **How long would it take to manufacture or modify a trolley?**

To provide the Centre with a recommendation for manufacturing the trolley design, we located manufacturers. We broke our search into several categories: manufacturers who could provide us with an “off the shelf” trolley, manufacturers who could build a custom trolley, manufacturers who could modify an existing trolley, and suppliers who could provide parts that could be used to modify a trolley.

We utilized two methods to find these companies: searching the internet and phonebook and using the “snowball sampling technique.” The searches conducted on the internet and in the phonebook were severely constrained because of the language barrier. We were able to get help from Khun Koy, a worker at the Centre, to translate some of the companies in the phonebook, but we generally only contacted the manufacturers with pictures illustrating their products or an English website so we could be certain that they had products useful to us. The language barrier was also a problem when we contacted these companies. Thus, we had to use mainly email to communicate ideas; this process progressed much more slowly than phone conversations most likely would have.

The second method we applied, the snowball sampling technique, is used when one’s knowledge in a certain area is not extensive. The basic premise is that someone who has limited knowledge in a certain area discusses the situation with a person who has more knowledge in that area to learn about possible contacts. The second group of people would then suggest others who have an even greater familiarity with the topic, and the process repeats (Berg, 2007). The snowball sampling technique was not very beneficial for us because it was limited by the knowledge and associations of the initial contacts; we did not know of anyone particularly knowledgeable about food trolley suppliers or manufacturers.

Using the contacts found through our research, we inquired about companies’ specific products and skills. This information was used to further develop our preliminary ideas into designs that could be reasonably manufactured. Because the Centre has a limited budget and would like an improved trolley as soon as reasonably possible, we also sought information on the cost and timeline of manufacture. When talking with suppliers and manufacturers, the language barrier created a challenge. However, using our limited Thai vocabulary and the aid of Khun Koy as well as Khun Jieab, an Administrative Assistant at the Centre who speaks Thai and English, we were generally able to communicate effectively. Utilizing the methods

described, we were able to create a trolley design specific to the Centre's needs and determine a manufacturer for the Centre.

4.0 Findings

In this chapter we began by presenting the findings of the needs assessment, which revealed some common concerns about the trolley across stakeholder groups as well as features of the current trolleys that staff wanted to keep. We then synthesized this information by presenting objectives and functions important for a new trolley and discuss possible design features to address these requirements. Finally, we present the findings of our search for manufacturers and analysis of the staff's attitudes towards the new trolleys.

4.1 Needs Assessment

By analyzing the information we gathered through interviews, observational studies and a survey in the needs assessment, we identified the expectations that each stakeholder had of the food delivery system. Further, we ascertained the extent to which the current system met these expectations, which elements of the current system could be feasibly changed, and gained an understanding of how the management and staff interacted. The following is a list of these findings. An in depth summary of the information gathered is in Appendix C.

The trolley must be compatible with the current system for food preparation and delivery

Through observations and interviews, we identified that the kitchen staff cooks and prepares meals for all of King Chulalongkorn Memorial Hospital, which can have up to about 1500 patients. If the cooking method or the overall delivery system were changed, the kitchen set up and the work tasks of many people would be affected. We could not have changed any part of the system that would require more workers to be hired because the kitchens are part of a public hospital with limited funding. Because we identified that these options were outside of the scope of our project and the Centre was not interested in changing these aspects of the food delivery process, we did not pursue them.

The trolley must have space for 32 plated meals, several liquid meals, and containers and supplies for bulk food

Currently, the trolleys at the Centre can hold 32 plated meals which measure 40.6 cm x 30.5 cm x 7.6 cm. Also, the tops of the current trolleys are used to contain bulk food, trays for bulk food, liquid meals, and a garbage bucket. The various items and their dimensions are

shown in Appendix C, and a picture of the top of a loaded trolley is shown in Figure 15. It is not feasible to make the trolley smaller because then each trolley would need to make multiple trips to deliver the same amount of meals. The hospital's budget constraints make it not possible to hire more workers or pay existing workers to complete the extra work. The number and size of the items on the trolley varies significantly depending on the trolley's route. From these observations, we determined that the trolleys have some excess space. Based on the size of these items and our observations of the trolley loads, we concluded that the trolley should have at least 0.581 m² (900 in²) for storing bulk food and liquid diet items.

The meal plating system does not need to be changed to improve patient satisfaction

According to the exit survey conducted by the King Chulalongkorn Memorial Hospital, over 90% of patients who received normal meals were satisfied with the food temperature, texture, crockery, and cleanliness. Thus, we concluded that the current plating system is effective in containing the food and keeping it at a temperature which is suitable to most patients. Figure 16 shows a pie chart of the results of the survey and the more detailed data is shown in Appendix C. We concluded from these data that most patients are generally satisfied with food delivery, and no changes related to food temperature are needed.



Figure 15: Food Trolley Holding Bulk Food Containers & Trays, and a Liquid Meal

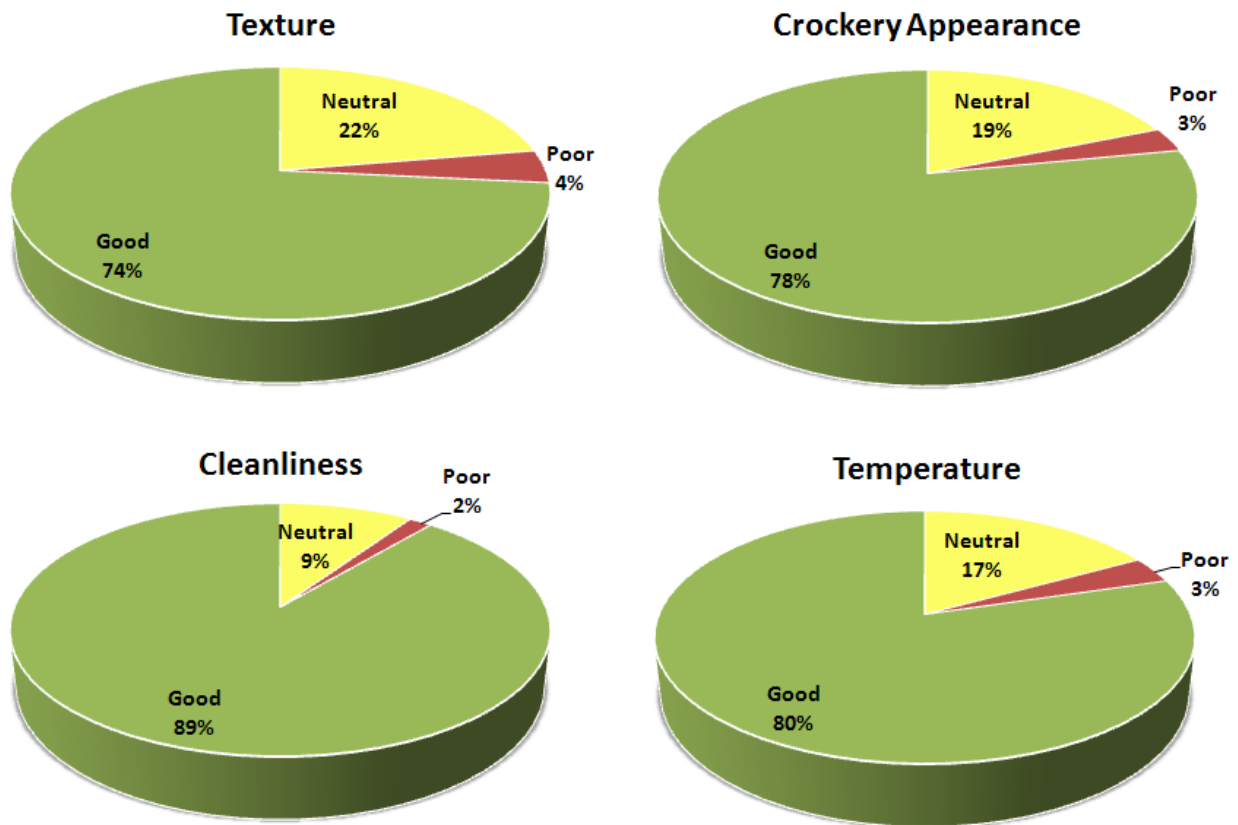


Figure 16: Sep. 2008 Survey Results of Those Patients who Received 'Ordinary Meals'

The new trolley should be maneuverable enough to easily go through elevator doors, make turns, go up and down inclines, and traverse rough ground

All stakeholders indicated the need for the trolley to maneuver well. Through our observational studies, we determined that the trolley has to travel over some uneven sidewalk surfaces, in and out of elevators, and up and down ramps; an example of these surfaces can be seen in Figure 17. The women operating the trolleys told us throughout the interviews that it was difficult to push and turn the trolley. This was caused largely by the trolley's third wheel which stuck out past the back edge of the trolley and prevented the operators from being able to stand directly behind the center of the trolley. The third wheel can be locked under the trolley body so that it does not impede the operator's space, but this causes the trolley to be unstable. Most operators choose to have the wheel protrude so that the trolley is more stable. Figure 18 shows a picture of the wheel inhibiting a trolley operator. We determined that maneuverability was an essential quality for trolleys, and the current trolley was not providing adequate maneuverability.



Figure 17: Uneven Surfaces Which Trolley Has to Travel Over



Figure 18: Trolley's Third Wheel that Inhibits the Operator's Ability to Push the Trolley

The weight of the current trolley presents a safety concern and makes the operator's job difficult

Although we were unable to weigh a trolley or the food that it transports, the trolley operators conveyed to us that the trolleys are very heavy. The weight makes the trolleys difficult to stop, especially when traveling down an incline. Because most of the current trolleys at the Centre don't have brakes, if the operator needs to stop the trolley, he or she must lean back and use his or her own body weight to counteract the momentum of the trolley. The limited ability for the trolleys to stop quickly makes them more likely to collide with the Centre's patients, staff, and visitors, presenting a safety concern.

The weight of the food trolley also makes the operators' work more difficult and has the potential to negatively impact their health and well being. We observed that the trolley operators had difficulty pushing the trolleys up hills and sometimes needed help. These efforts to push the trolleys present a risk of the operators straining or injuring themselves.

The large size of the current trolleys inhibits the visibility of the operators and creates a safety concern

One of the major concerns of both Finola Chatamra, an honorary advisor at the Centre, and the trolley operators was that the current trolleys compromise the safety of people around the hospital. The operators cannot see well in front of the trolleys because they are tall and wide. In the kitchen, we witnessed a food trolley hitting another smaller trolley and concluded that the operator's limited visibility led to the collision. These same trolleys traverse the hospital through crowded walkways. Although the operators currently ring a bell to make people aware of the trolley's presence, we observed that people did not always move out of the way. Small children especially would be less likely to heed to the bell's warning and more difficult for the operator to see. Thus, the operator's limited visibility results in the trolley being potentially harmful to people around the hospital.

The new trolley should not have any sharp edges or protruding elements

Although the stakeholders did not explicitly mention other aspects of the trolley concerning safety, we determined that the trolley should not have sharp edges or protruding elements. The trolleys are surrounded by people when they are loaded in the kitchen and transport food throughout the hospital. Thus, it is likely that people bump into the trolley, so sharp or protruding edges would be dangerous.

The new trolley should not damage the walls

One of Khunying Finola's major concerns is that the trolleys damage the walls at the Centre. There are smudges and knicks on the corners of the walls around the elevators as illustrated by the picture in Figure 19. Because heights of the different knicks vary, we suspect that this damage is from a combination of items such as: gurneys, other carts and trolleys. Though we did not see any food trolleys hit the walls, it is likely that some of the damage was caused by them because the trolley is so difficult to control. The large size, weight, and poor maneuverability of the trolley are main factors which contribute to this lack of control. The trolley has bumpers to account for these factors, but they do not adequately prevent damage to the wall. As the picture of a trolley's bumper in Figure 20 shows, they only cover the corners of the trolley. Thus, they do not provide any buffer between the walls and the sides of the trolley which could damage the walls when the trolley turns around corners.



Figure 19: Damage of the Centre's Walls



Figure 20: Bumpers on a Current Trolley

The new trolley should provide the operators with easy access to the food trays and contain their cleaning supplies

The operators' jobs require them to move food trays into and out of the trolley. The current trolley doors slide sideways to allow the operators to load and unload trays in the trolley. Figure 21 shows a picture of these doors. The operators explained that the doors on the current trolley are difficult to open, and we confirmed this through an observational study. A lot of force had to be used to push the doors open, most likely because there were no wheels on the door runner to help the door slide easily. With a new trolley, the operator should be able to easily gain access to the food.

In addition to putting meals into and out of the trolley, the operator must clean the used plates before transporting them back to the kitchen. Some of the trolleys that the Centre currently uses have a storage box on the trolley to hold the operator's cleaning supplies. The operators informed us that they find the box useful, but during the interview, the box's top fell on Khunying Finola's fingers. Thus, we concluded that the new trolley should have a space for the supplies, but should also be user friendly so the operators do not have their hands pinched.



Figure 21: Doors on a Current Trolley

The current food delivery system causes a significant amount of waste

Another concern of Khunying Finola was the amount of cling wrap used and discarded by the Centre. Each of the five dishes per patient meal is covered in a layer of cling wrap before being loaded into the food trolley. The kitchen management identified that the reasoning behind the cling wrap was to help keep the food warm and prevent spillage. We also observed that the cling wrap helped to protect the food from contamination.

Although we were unable to confirm our conclusion, we suspect that the Centre uses a PVC based cling wrap because of its physical properties. PVC cling wrap is very difficult to recycle and can contaminate batches of other types of recyclable plastics. Further, there are many additives in the plastic that can leach into the environment after disposal (Scheirs, 2003). Thus, the amount and type of waste produced by the food delivery system could be potentially hazardous. However, eliminating the use of cling wrap would likely require changes in the current food preparation and delivery systems, and the kitchen staff and trolley operators did not express any concerns about this waste.

The trolley should be able to be relatively quickly and locally manufactured for a reasonable price and with reliable customer service

The new food trolley should use materials and designs that a local company could manufacture or purchase. Also, the kitchen management felt that the customer service of the current trolley company was inadequate because they did not address the trolley's problems promptly. During our discussions with Khunying Finola and the kitchen management, it

became evident that the employees at the Centre were not knowledgeable about food trolley intricacies or manufacturers. Thus, the Centre needed to be provided with the contact information for a company that could manufacture the new trolley. This company should also be capable of providing customer service to fix the trolley if there are problems.

4.2 Design Objectives, Functions, and Constraints

We synthesized the findings from the needs assessment into two types of design considerations:

- Objectives and Functions: stakeholders' goals for the project and tasks that the trolley has to be able to perform
- Constraints: measurable limitations that restrict the trolley design

These two types of considerations shaped the new trolley design. To understand and organize the objectives of the design, we constructed an objectives tree shown in Figure 22. This diagram gives a visual representation of the different aspects of each objective. Shown below the objectives tree are the list of objectives and functions and the list of constraints.

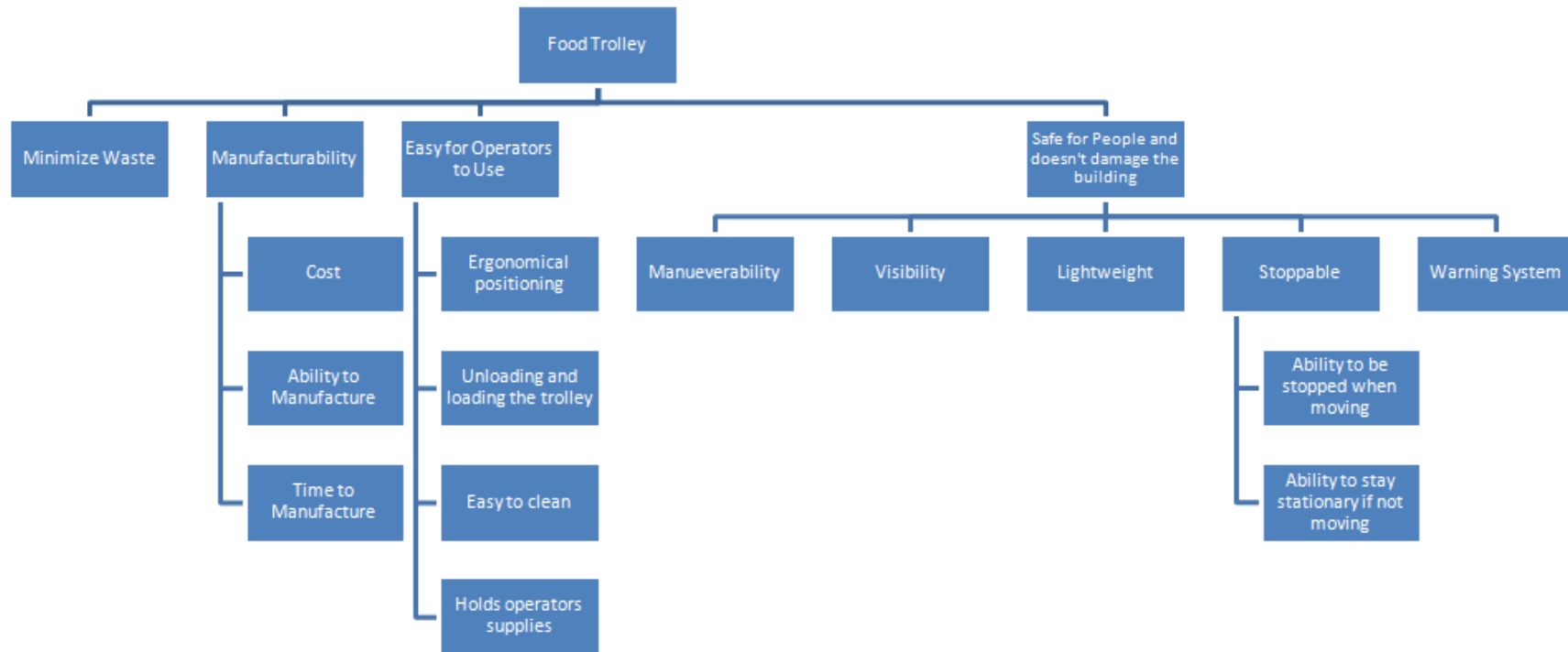


Figure 22: Design Objective Tree

Objectives and Functions:

- **Safe and does not damage the facilities**
In order for the trolleys to be safe, they should: be easily maneuverable, be as lightweight as possible, have some mechanism of stopping, have a mechanism to hold them stationary, allow the operators to see around them, and have a warning system to alert people of their presence. The trolley should also have a mechanism to prevent damage to the Centre's walls.
- **Helps the operators carry out their tasks**
The trolley should have doors that are easily opened and closed to allow the operators to access the food. The trolley should also be capable of storing and providing easy access to their cleaning supplies.
- **Capable of being locally manufactured relatively quickly**
In order for the Centre to have a trolley that meets their requirements, it must be capable of being manufactured reasonably quickly.
- **Reduce Waste**
The food delivery system should transport the food in containers that produce as little waste as possible. The current food delivery system uses large quantities of cling wrap which are not reusable or recyclable.

After we had developed this list of objectives and functions, we shared it with the trolley operators, kitchen management, and Khunying Finola to solicit their feedback. The trolley operators did not openly support the objective pertaining to the trolley not damaging the walls. It is possible that the operators did not want to admit that the current trolleys were damaging the walls in the presence of their supervisors because they may have felt responsible for the damage.

Constraints:

- **Hold 32 trays of plated meals and carry liquid meals and bulk food**
Because the food delivery process cannot be changed, and the budget of the hospital is limited, the trolleys must be capable of transporting the quantities of food and

meals stated above. The plated meals are 40.6 cm long 30.5 cm wide 7.6 cm. tall. The space for holding bulk food should be no smaller than 0.581m² (900in²).

- **Be no more than 150 cm tall, 250 cm long and 110 cm wide**
In order to fit inside the elevator at the Centre and not severely restrict the visibility of operators, the trolley must be smaller than the above dimensions.
- **Cost no more than 63,000 Baht to manufacture**
In order for the Centre and Hospital to be able to afford the trolley, we determined that it should not cost more than the current trolley. The figure 63,000 Baht was calculated by using the cost of the current trolley when it was purchased ten years ago (50,000 Baht) and adjusting for inflation.

The trolley design was significantly constrained by the amount of food the trolley needed to hold. We determined that the food accounted for a large portion of the trolley's weight, and thus we could not fully address the stakeholders' wishes for a lighter trolley. We designed the new trolley be more compact and thus lighter than the current trolley. However, we suspect that the trolley will still be heavier than the stakeholders would like, so we focused on addressing the safety issues caused by its weight, such as the trolley's poor stopping ability and limited maneuverability.

The manufacturability of the various elements also constrained the new trolley design. We had to develop a design that consisted of parts and materials that were readily available in Thailand and design the body and components so that manufacturers in the area could construct them inexpensively.

4.3 Components and Features of the Food Trolley

Based on our needs assessment of the Centre, we generated design ideas for the different components of the trolley. Each component is listed below with a brief discussion of its contribution to achieving the objectives and carrying out the functions. For an in depth summary of what our group considered please reference Appendix D.

Wheel Selection Considerations

Currently, the trolley has 16" wheels to ensure that it can traverse the uneven ground between the kitchen and the Centre. The use of smaller inflatable rubber tires would lower

the trolley and increase the operator's visibility. However, these wheels would still need to be large enough for the trolley to smoothly traverse the rough terrain. These wheels could be positioned under the trolley near the corners to prevent the restricted visibility of the trolley operator and still provide stability.

We determined that rubber inflatable tires would absorb shock when the trolley goes over the uneven surfaces, whereas a hard caster wheel would most likely jostle the trolley and food. This vibration could reduce the food's visual appeal and cause the operator strain. We considered implementing a shock system, but heard from Bumrungrad Hospital that their trolley's shock absorbing system was defective when the trolley had to carry a lot of food. Further, the 8" inflatable tires are readily available. We also considered the benefits of both stationary and swiveling wheels. If the front two wheels were stationary, the trolley would not be inclined to turn unexpectedly when it is going over rough terrain. The two wheels closest to the trolley operator could be capable of swiveling, which will allow the trolley to pivot and turn easily.

Considerations for Containing the Items on Top of the Trolley

The current trolley has one containment rack that runs around the top of trolley approximately 10cm above its surface to contain the bulk food containers. Figure 23 shows a picture of the current containment rack. During our meeting with a trolley operator, he indicated that a second lower containment rack located between the upper bar and top of the trolley would be beneficial in order to contain small items.



Figure 23: Containment Rack on a Current Trolley

Considerations for the Trolley's Warning System

The current trolley has a bell to warn people when it approaches. Though people do not always move out of the way, they seem to look in the direction of the bell and see the trolley coming. We do not believe that there is any reasonable method of forcing people to move, but the bell seems to be an adequate indicator of the trolley's presence.

Material Selection

The kitchen management explained that they wanted a stainless steel trolley because they have had trolleys rust in the past. Though the trolley could also be made out of other metals that don't rust, the manufacturer expressed that they had experience with stainless steel and were comfortable using it to construct trolleys.

Options for an Improved Storage Box

Some of the current trolleys have storage boxes which the operators conveyed were an adequate size to hold their cleaning supplies. A picture of the current box can be seen in Figure 24. Positioning this box against the trolley body underneath the trolley handle would not increase the size of the trolley and would allow the trolley operators to conveniently access it.



Figure 24: Operator's Supplies Box on a Current Trolley

We observed and were informed by the kitchen staff that the cover was necessary to make sure food from the bulk meal containers didn't fall into the cleaning supplies. However, the current box cover could easily close on the operator's hands. We determined that a new cover could be designed to open past ninety degrees before resting against the

body of the trolley by placing the cover's hinge 2.5 centimeters (about 1 inch) away from the edge of the box. This design would be easy to manufacture, would not change the box opening procedure, and wouldn't impact the operators' abilities to access their supplies. We also considered a box with a locking arm mechanism to hold the cover open. However, the operators did not explicitly express the need for a new cover, and this mechanism would complicate the box opening procedure.

Brake Handle Alternatives

The operators expressed the need for a hand brake to increase their control of the trolley and communicated that the hand brakes on some of the current trolleys adequately stop the trolley. The current design uses friction between the brake pad and a disk connected to the trolley's wheel to stop the trolley. The brake is engaged by cables that are connected to a brake handle, and we determined that this design can be easily manufactured. Another braking system we investigated held the trolley stationary unless the brake handle was engaged. We determined that this might be inconvenient for the trolley operators, and the constant hand exertion could strain their forearms.



Figure 25: Brake on a Current Trolley

While the current brake mechanisms seen in Figure 25 work well, the brake handles are inconvenient for the operators to use because they are located 10 cm below the trolley's handle. Pictures of the current brake handle are shown in Figures 26 and 27. We determined

that using a brake handle placed in front of the trolley handle, similar to a mountain bike brake, would make it less awkward to use. This new configuration would allow the operators to pull on the brake without changing their hand positioning so they could engage the brake more quickly, making the trolley safer to operate. A picture of this positioning is shown in Figure 28.



Figure 26: The Operators' Normal Pushing Position



Figure 27: An Operator Using the Current Brake



Figure 28: Example of Brake Layout that Could be Used on the New Trolley

Foot Brake Options

A Trolley should have a means to keep itself from moving when it is being loaded and unloaded and while it is unattended. The current trolleys use a footbrake that effectively keeps the trolley stationary. However, because a new trolley would have swivel wheels, we determined that it would need two locks to keep from rotating. By having these brakes on the swivel wheels, the operators would be able to easily push the brake down without walking to the other end of the trolley. However, the trolley operators may not like using two of these wheel locks instead of the one currently used.

Optimizing the Space of the Trolley

We concluded from our interviews with trolley operators and observations that the current method of holding food on the trolleys is efficient. In order to improve visibility, the operators could place bulk meal containers on removable inserts inside the trolley. These inserts would be designed to have similar dimensions to the food trays, but made out of stainless steel to support the weight of the bulk containers. Moving the bulk containers inside the trolley when it is not completely filled with plated meals would improve the operator's visibility, thus making the trolley safer. However, an operator may have to bend down to access the pots. We were unable to discuss this design with the trolley operators, but the kitchen management was concerned that often times the trolleys were quite full, so there might not always be space for the bulk containers within the trolley body.

Door Design Options

Contrary to the current sliding door design, two hinged doors on the trolley body would be easy to open and give the operator access to both compartments of the trolley at once. The kitchen staff also noted that hinged doors would make the trolley easier to clean. The operators often had to reset the sliding doors when they became dislodged from their runners, and the swinging doors would eliminate this problem as well. We recognized that because they swing out away from the body, these doors might present a safety concern or be damaged in a busy kitchen. However, Bumrungrad hospital uses the swinging door design in a similarly busy kitchen, and during an interview, the manager claimed that safety and damage were not an issue. However, the vertical locks used on the Bumrungrad trolleys often come unlatched while the trolleys transported food, allowing the doors to swing open. Thus, a horizontal sliding lock mechanism could ensure that the doors stay closed while transporting food. Both the hinged door and horizontal lock can be readily manufactured.

Improving the Bumpers

As discussed in the needs assessment findings, the current trolley only has bumpers on the corners, which do not protect the corner of the wall from the sides of the trolley. The current bumpers can be seen in Figure 20. Although a black rubber bumper could be installed around the entire bottom edge of the trolley, this material could leave black scuff marks on the wall. Another option is for the trolley to have non-marking bumpers that would not scuff the Centre's walls, but would only cover the four bottom corners of the new trolley similar to the bumpers on the current trolley. These bumpers would leave the edges of the trolley exposed to damage the walls. We were unable to find a supplier who produced a non-marking bumper that could cover the entire bottom edge of the trolley.

4.4 Manufacturing and Implementation Issues

To complete our recommendations to the Centre, we searched for manufacturers that could fabricate a custom trolley for the Queen Sirikit Centre for Breast Cancer. We further combined our research of implementing change, Thai values, and business structure with our observations of the Centre to draw conclusions about the opinions of the staff with regards to the idea of a new trolley. In this section, we discuss the results of our manufacturing and implementing change research.

Trolley Construction Options

Thai Trolley was the only local company we determined able to produce a custom trolley, and they are located just outside of Bangkok in Samutprakom. We contacted ten other manufacturing companies, but they were either not locally based or could not construct a custom trolley. We determined that the trolley manufacturer needed to be local so that the Centre would not incur unnecessary and expensive shipping fees. A list of the manufacturers we contacted and their contact information is shown in Appendix E. We determined that Thai Trolley offers a one year warranty on their trolleys. They will also continue to perform on site maintenance for the trolley after this period. Judging by the nature of the Thai Trolley representative's comments, they seem knowledgeable about food trolleys and some of their common issues and best practices. Further, Thai Trolley manufactures various trolleys for a wide range of clients, including the current linen trolley at the King Chulalongkorn Memorial Hospital. Although we were unable to obtain the opinions of people using these trolleys, the service and knowledge Thai Trolley demonstrated led us to believe that they would provide adequate customer service.

Price Considerations

Thai Trolley produced a cost estimate of about 53,000 baht to produce the current trolley at the Centre. The hospital paid 50,000 baht ten years ago, which translates to about 63,000 baht by today's standards, which is 10,000 baht less than the price suggested by Thai Trolley. Thus, based on this comparison, we determined that Thai Trolley offers competitive prices within the hospital's price range. Further, Thai Trolley would be able to construct the custom trolley 20 days from the time of the order.

Staff and Management at the Centre Appear Inclined to Accept the New Trolley

Based on our regular interactions with both the kitchen management and trolley operators, the stakeholders seem open to the idea of a new food trolley. Contrary to the suggestions of our research, the trolley operators appeared to have positive outlooks towards the idea of a new trolley, and further seemed to openly critique both the current trolley and designs for a new trolley. We suspect that our experience differed so significantly from our research in part because it appears that the work environment at the Centre is open and supportive, giving the staff the confidence to share their negative feelings about the trolley.

Both the supportive environment fostering communication and the staff's positive view towards a new trolley increase the likelihood that the change will go smoothly.

5.0 Recommendations

In this chapter we present a custom food trolley design that we recommend for the Queen Sirikit Centre for Breast Cancer. This design reflects the desired objectives and necessary functions identified through consultation with all major stakeholders. We also provide recommendations for modifications that would deal with some of the problems that cannot be addressed by the new food trolley alone. Additionally, we recommend steps the Centre can follow to manufacture and implement the trolley design.

5.1 Trolley Design and Fabrication

We recommend that the Queen Sirikit Centre adopt the custom trolley design shown in Figure 29. This trolley better suits the needs of the Centre by improving upon the current features and incorporating new features designed to make the trolley: safer, less likely to damage the building, and easier for the operators to use. Based on our discussions, the design seems to have been well received by most of the kitchen management and trolley operators. Following is a list of the features and a brief explanation of their benefits. Detailed engineering drawings of the Custom Trolley can be found in Appendix F.

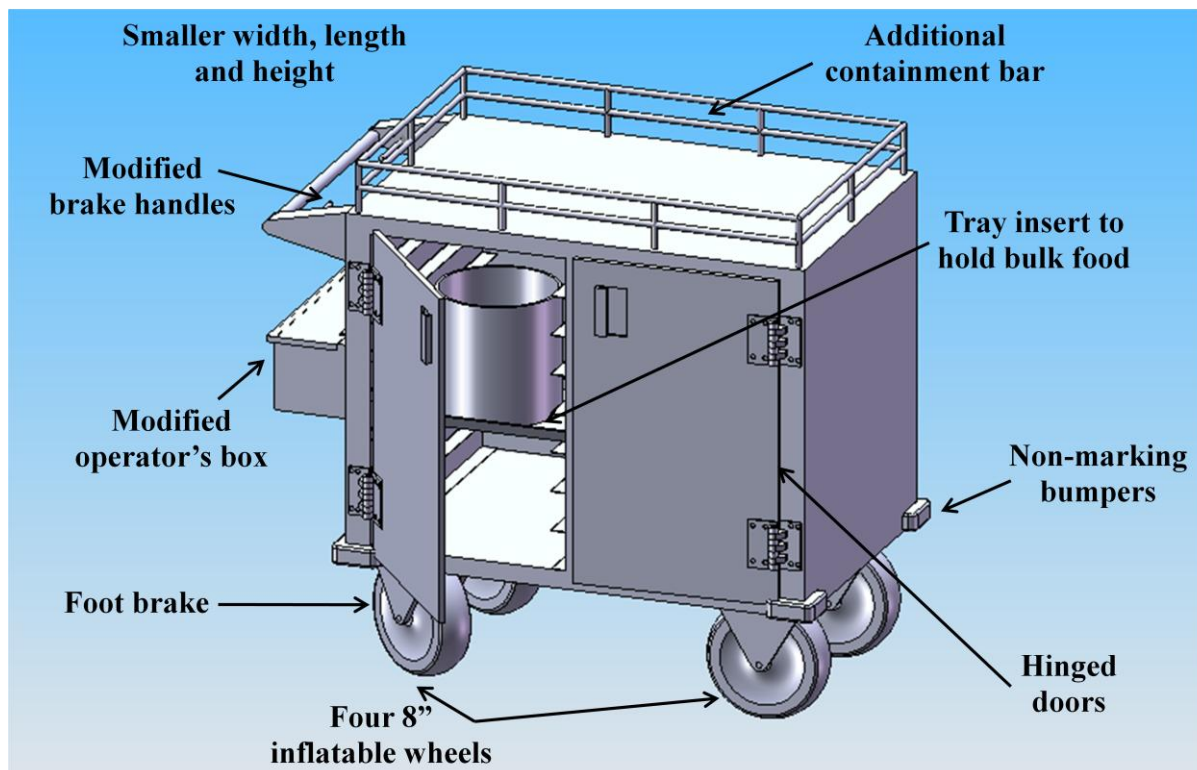


Figure 29: A Custom Food Trolley Design for the Queen Sirikit Centre for Breast Cancer

- **Four 20.3 cm (8 in) inflatable wheels: two stationary opposite the handle bar and two that swivel under the handle bar**

These wheels should increase the stability and maneuverability of the trolley while maintaining most of the benefits of the current 40.6 cm (16 in) inflatable wheels. They will also decrease the height of the trolley to give the operators greater visibility.

- **A box fixed to the trolley to hold the operator's supplies**

This box will be capable of storing all of the operator's supplies and is designed so that the cover will not fall closed on the operator's hands.

- **A hand brake with the brake handle positioned in front of the trolley handle**

Hand brakes will increase the safety of the trolley by providing the operators with better stopping ability. The new handle positioning should also be more convenient for the operator to use than the brake handle on some of the current trolleys.

- **Two foot brakes to keep the trolley stationary**

The foot brakes will also increase the safety of the trolley by allowing the operators to lock the trolley in place when it is being loaded, unloaded, or is left unattended.

- **Hold plated meals within the body and bulk meals on top of the trolley**

We concluded from our interviews with trolley operators and from our observations that the current method of holding food on the trolleys is efficient.

- **Have an insert that can be put inside the body to support bulk food**

If the trolley body is not fully loaded, the insert will allow bulk food to be put inside the trolley, decreasing the overall height of the trolley and increasing the operator's visibility.

- **Two containment bars on top of the trolley**

The additional bar will be located under the current containment bar and will help contain smaller items which can slide under the taller bar.

- **The same bell as the current trolleys**

It appears that the current bells adequately make people aware of the trolley. Because there is no reasonable manner in which the trolley could *force* people to move, we recommend that the same bells be reused on the new trolleys.

- **A trolley body that is approximately 0.127 m³ (4.5 ft³) smaller than the current trolley body**

The smaller trolley body will be able to contain 32 trays like the current trolley, but it will make the trolley easier to navigate in tight areas and decrease the weight by at least 7.5 kg (16.85 lbs).

- **Constructed out of stainless steel**

The stakeholders at the Centre expressed the desire for stainless steel trolleys, and the manufacturer is comfortable working with this material.

- **Two hinged doors that open outward on both sides of the trolley**

These types of doors should give the operators easy access to the food and will also make the trolley easier to clean. The proposed doors will lock so that they do not unintentionally open during transit.

- **Non-marking rubber bumpers on the four bottom corners of the trolley**

These non-marking bumpers will provide a buffer between the walls of the Centre and the corners of the trolley, and they will not leave any marks on the walls. However, they will not protect the corners of the walls from the sides of the trolleys. Please see the ancillary recommendations for how we propose the corners of the walls be protected.

We recommend that the Centre have the trolley manufactured by Thai Trolley, a trolley manufacturer located just outside of Bangkok in Samutprakom. They could manufacture the initial trolley for 45,000 baht in twenty days or less. If the Centre and the hospital decide to purchase large quantities of trolleys, Thai Trolleys would offer decreased pricing. Trolleys two through five would cost 42,500 baht, and the price would further decrease if more than five trolleys were purchased. They also provide a one year warranty on their products and will offer onsite maintenance during and after the warranty period if required. Their contact information is located in Appendix E.

5.2 Ancillary Recommendations

We also recommend that the Centre make modifications to the food delivery system that would manage some of their problems not fully addressed by the custom trolley. In this section, we present recommendations to further protect the walls of the Centre and reduce the waste generated by the food delivery system.

PLACE CORNER GUARDS ON THE CORNERS OF THE WALLS NEAR THE ELEVATORS

Although the bumpers will provide a buffer between the walls and corners of the trolley, it is possible that the sides of the trolley could rub against the corner of the wall.

Thus, in order to completely protect the walls from the trolley, we recommend that the Centre install corner guards on the walls near the elevators. These corner guards should be made of metal with an outside layer of PVC to provide protection for the walls. PVC corner guards do not require paint, so no paint will chip, and the Centre's appearance will be better preserved. We recommend that the Centre purchase these corner guards from Phitphisarn, a local company located in Thailand that provides this type of corner guards. They can supply the corner guards in a variety of colors. The contact information for their sales office is located in Appendix E.

CONSULT WITH THE KITCHEN STAFF AND TROLLEY OPERATORS REGARDING THE IMPACT OF REUSABLE CONTAINERS

Through our research, we discovered reusable sealable containers that the Centre could use to eliminate their need for cling wrap to cover the food. Although these containers might produce less waste, more research would need to be done into the overall environmental impact of both sets of dishware. Further, cleaning the new dishware could create extra work for the staff and affect the timing of the kitchen. The kitchen staffing could have to be reorganized to continue to serve meals on time. Thus, we recommend that Centre look into the implications of adopting reusable sealable dishware before making the decision to adopt it. Please see Appendix G for our initial analysis and in depth recommendations. Should the Centre decide to use reusable closable containers, contacts for possible manufacturers are located in Appendix E.

5.3 Implementation of the Trolley

We developed the following recommendations for the Centre to most successfully implement the new trolleys.

INITIALLY PURCHASE ONLY ONE TROLLEY

We recommend that the Centre purchase one trolley with the proposed design to test before they commit to buying all five trolleys. Although the trolley design seemed to be well accepted by the staff, we only discussed the proposed changes with a few trolley operators and members of the kitchen management. If we continued to gather feedback on the design, the trolley operators would most likely be speculating on the functionality of design details. After seeing and using the new trolley, more staff members will have a tangible sense of

which features work well. Further, there may be unforeseen problems with some of the new design features, so the Centre may need to make modifications. Therefore, we recommend the Centre test the trolley until the operators and management have critically discussed the different features and recommended any necessary modifications. If required, the Centre should have Thai Trolley adjust the trolley design before purchasing all trolleys.

PRESENT THE CENTRE'S TROLLEYS AS TRIAL TROLLEYS THAT COULD LATER BE ADOPTED BY THE ENTIRE HOSPITAL

Khunying Finola, an honorary advisor of the Centre, indicated that the trolley design might be accepted by all of King Chulalongkorn Memorial Hospital in the future. Thus, in order to minimize jealousy and tension that may develop between the Centre's trolley operators and the operators who deliver food to other divisions of the hospital, we recommend that the management inform the operators that the Centre's trolleys are intended for and will hopefully be adopted by the entire hospital.

HAVE UPPER MANAGEMENT SHOW SUPPORT FOR THE NEW TROLLEY THROUGH A BRIEF APPEARANCE AND STATEMENT BEFORE THE TROLLEYS ARE INTRODUCED

Our research suggested that upper levels of management can have a large, positive influence with limited involvement by showing their support for the new trolley. Thus, we suggest that the director of the Centre, Dr. Kris Chatamra, meet with the trolley operators and give a brief statement before the trolleys are introduced to reiterate that the trolley was specifically designed for the operators and to encourage their feedback. The statement should ensure that all members of the staff are aware of the proposed change and its potential benefits before the trolley is brought to the Centre, which will aid the implementation process.

WE ENCOURAGE LOWER LEVELS OF MANAGEMENT TO MEET WITH THE TROLLEY OPERATORS AT LEAST ONCE TO DISCUSS THE NEW TROLLEYS

Because they have a closer relationship with the staff, the lower level managers and supervisors should maintain open lines of communication with the staff regarding the introduction of the new trolley. To allow the operators to express their opinions, as experts suggest is necessary for effective change, the management should have an informal meeting with the trolley operators one or two days after the trolley is introduced. This meeting should

occur after the operators have had time to use the new trolley so they can voice any concerns before the concerns develop into strong negative opinions about the trolley. The management should try to address these worries to the best of their ability and discuss the benefits of the new trolley. The operators' opinions will be the primary source of feedback, so their concerns should be taken seriously and addressed if necessary.

5.4 Summary

Our goal was to provide recommendations for improving food delivery at the Queen Sirikit Centre for Breast Cancer. We have provided the Centre with the design for a new trolley and plan for manufacturing and implementing it. We also made several ancillary recommendations for improving the food delivery system. Improving the food delivery system will benefit the operator's health and the safety of people at the Centre. A food delivery system that doesn't compromise the building, patients, or staff and can effectively deliver the food patients need will help the Centre to provide holistic healthcare.

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Appendix A: Interview and Observational Study Templates

Interview with Khunying Finola Chatamra

Opening Questions:

- How long have you been at the Centre?
- How many total employees are in the hospital?
- How many managers directly report to you? Who do the Maintenance and Kitchen Staff report to?
- Do you have an organizational chart of the Hospital Staff?
- How many food trolleys are in your facility?

Opinion:

Damage

Our group was under the impression that the Food Trolley was causing damage to the walls, is this correct?

- Do any other objects in the hospital cause similar damage such as hospital beds, wheelchairs, various equipment, etc.?
- Have you tried anything to prevent this damage yet, such as wall guards?

Wheels

We also heard that the wheels had been problematic, is this also correct? What is problematic about them?

- Do they have trouble going outside or over carpet or tile?
- Do they have trouble turning with the current wheels?
- Have you tried any other types of wheels?

Staff/Safety

We have the impression that some staff feel the trolley is unsafe. Why do they feel that?

- Do people burn themselves on it?
- Is it difficult to maneuver?
- Do people have trouble seeing over it or around corners?
- Do people have trouble stopping the trolley, especially if it is on a - downward slope?
- Are the edges sharp?
 - Do they pose a threat to patients and staff?

Size

Do you think the size of the trolley is appropriate?

- Do you need the trolley to hold more food than it does currently?
- Is there extra space in the trolley?

Food Quality/Survey

Have you had any complaints about the food quality in regards to the quality of the food?

- Have you heard of any complaints about the temperature of the food?
- Have you tried conducting any patient surveys to gauge their satisfaction with the current food?

General

What aspects of the hospital do these problems affect (i.e. building, particular staff members etc)

- Do you notice that these problems affect the staff?
- Have you ever heard any feedback from the staff about the trolley, good or bad?

Interview with Kitchen Management

Date:

Time:

Location:

Members Present:

Hello. We are Stacy Rudolf, Kelly Johnson, and Mike Taglieri from WPI in the United States. We're trying to design a new food trolley for the centre that will make your job easier. Would you mind answering a few questions for us? You can refuse to answer any question or stop the interview at any time, and anything you tell us is strictly confidential.

The Meals in the Trolley:

How many meals are in the trolley?

Are there any health regulations for the trolley?

Which of the trolleys use the large pots on top?

How long can food be left in the trolley before it is served?

How many people do you service?

How many bowls are used for breakfast?

How many bowls are used for lunch?

Temperature of the food:

Do patients complain about the temperature of the food?

What foods are expected to be hot?

Current Trolley Manufacturer

Who manufactured the current trolley?

How much did you pay for the current trolleys?

How old are the current trolleys?

The Dishware:

Are there any issues with the current dishware used for the plated meal system?

How are the trays used for the public rooms?

Interview with Trolley Operators

Date:

Time:

Location:

Members Present:

Hello. We are Stacy Rudolf, Kelly Johnson, and Mike Taglieri from WPI in the United States. We're trying to design a new food trolley for the centre that will make your job easier. Would you mind answering a few questions for us? You can refuse to answer any question or stop the interview at any time, and anything you tell us is strictly confidential.

Do you prepare the food for both Chulalongkorn Hospital and the Queen Sirikit Centre for Breast Cancer?

What do you like about the current food delivery system?

What would make your job easier?

Can you tell us about the maneuverability of the trolley?

What specific foods do you prepare for the trolley? (i.e. rice, toppings)

What are the specific types of meals served for breakfast, lunch, and dinner?

Do you prepare different amounts of food for each meal?

Do you feel that the trolley affects how you have to cook and prepare the food?

Does the trolley design affect the timing of food preparation? If so, how?

Would it be easier to cook all the food at once/prepare the food in chunks?

Do you have to load food into the trolley?

Can you tell us about that process?

Is there anything that could make the process easier?

Do you push the food trolleys? If so where?

Is there anything else you would like to tell us about the food trolley or food preparation process?

Thank you for your time!

Interviews with Other Hospitals

Interview at Bangkok Nursing Home

Date:

Time:

Location:

Members Present:

Hello. We are Stacy Rudolf, Kelly Johnson, and Mike Taglieri from WPI in the United States. We're trying to design a new food trolley for the centre that will make your job easier. Would you mind answering a few questions for us? You can refuse to answer any question or stop the interview at any time, and anything you tell us is strictly confidential.

How many trolleys do you use at your hospital?

How many meals can go out per trolley?

How many times per day does each trolley go out to the patient wards?

What types of food do you serve?

Who do you serve?

Do the patients order their food before receiving it?

Does the trolley have to go outside?

Are there any inclines the trolley has to go up or down?

Does the trolley have an insulation system?

Are there any brakes on the trolley?

Does the operator unload the trolley on the patient wards?

How do you feel about the doors?

How often is the trolley cleaned?

Where is the trolley cleaned?

How do you feel about the wheels?

Is there anything you particularly like about the trolley?

Are there any food regulations from the government?

Other Observations:

Interview at Bumrungrad

Date:

Time:

Location:

Members Present:

Hello. We are Stacy Rudolf, Kelly Johnson, and Mike Taglieri from WPI in the United States. We're trying to design a new food trolley for the centre that will make your job easier. Would you mind answering a few questions for us? You can refuse to answer any question or stop the interview at any time, and anything you tell us is strictly confidential.

How long have you had the trolleys?

How does the meal delivery system operate?

How long will the plates keep the food warm?

What types of food do you serve?

How many meals can fit in each trolley?

How many meals do you need to serve?

Are there any foods you need to keep cold?

How is that food kept cold?

We see that there are bars on top of the trolley, do they serve a purpose?

Does the trolley have to go up or down any slopes?

Does the trolley go outside?

Are there any problems with the trolley?

Is the trolley heavy?

Are there problems with the height of the trolley?

Are there any problems with hitting people?

Are there any problems with the doors?

What are the bumpers for?

Are they effective?

Does the trolley ever run into walls?

Does it cause damage to the walls?

Are there any brakes on the trolley?

Do you know the manufacturer of the trolley?

Observational Studies

Date:

Time:

Group Member doing the observation:

Location of Observation:

What meal is being served? And what foods are being served?

Who is interacting with the trolley and what are they doing?

Person1 (name/job):

What are they doing with the trolley and where?

Do they appear to be having any issues?

Is there something that they are doing which seems to be very efficient?

Does the staff interact with any management? If so, who?

Did the staff member follow the directions of the manager? Did they appear to respect the manager?

Observations of Trolley:

Size and number of wheels:

Texture of wheels:

Dimensions of trolley:

Observations regarding doors:

Ease of use:

Opening mechanism (i.e. sliding, pull out, etc)

Other:

Type of serving system:

Does the trolley utilize any method of insulation? Explain.

Other observations:

Trolley Specific Observations:

Does it appear that the trolley operator struggles maneuvering the trolley?

If yes, where it occurred:

Trolley is slow to start	Yes	No
Trolley is hard to stop	Yes	No
Trolley does not fit in area	Yes	No
Trolley hit the wall	Yes	No
Trolley hit a patient	Yes	No
Trolley hit hospital equipment	Yes	No

Further explain any instances which were observed:

Appendix B: Specific Steps within the Design Process

Why-Why Diagram

A why-why diagram is a tool which aids the designer in exploring the root causes of a design problem. In order to construct a Why-Why diagram one starts with a problem and asks why it was happening. All of these potential explanations are written down. Then one asks why this new list of things is happening and writes these down. This step is repeated until one feels that they have looked deeply enough into the problem (Voland, 2004). An example of a Why-Why diagram is shown in Figure 30.

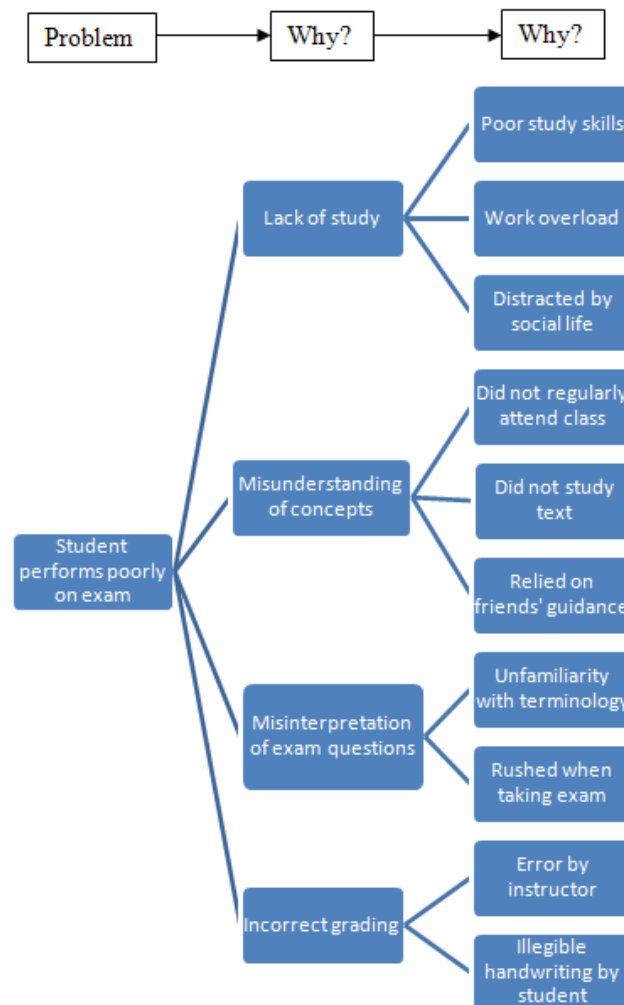


Figure 30: Example of a Why-Why Diagram

(Dym & Little, 2004)

Objectives Tree

An objectives tree is a graphical representation of the list of goals and subgoals for the product which is being designed. This list is made through determining the broad goals for the product and then elaborating on how those goals are defined using subgoals. An objective tree, such as the one shown in Figure 31, can create a deeper understanding of what is expected of the product without confining the designer to any specific means of doing it (Dym and Little, 2004).

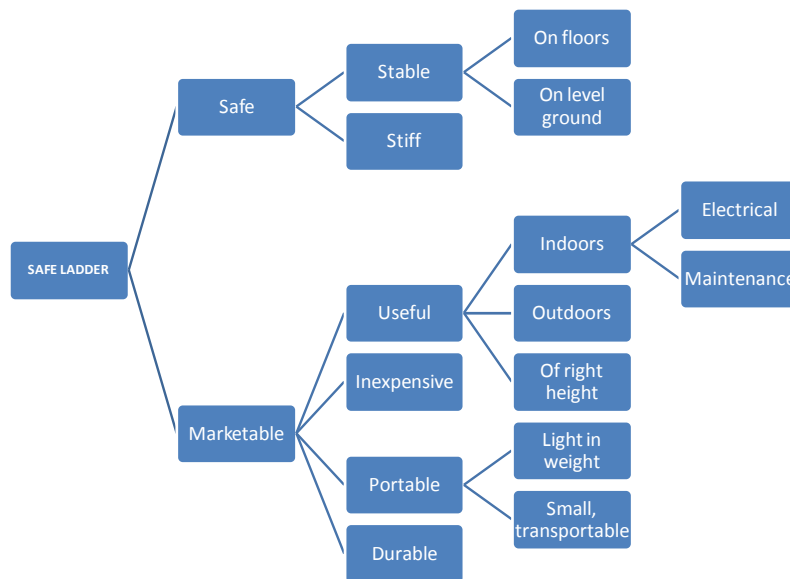


Figure 31: Objectives Tree Example

(Dym & Little, 2004)

Morphological Chart

A morphological chart is a tool to help organize ideas and see the scope of the design space. It can expand the possible designs by introducing new combinations of ideas. A morphological chart is constructed by writing down the list of either functions or features in the left hand column of a chart. The rows corresponding to these columns are then filled in with means of accomplishing these functions (Dym and Little, 2004). An example of a morphological chart is shown in Table 3.

TABLE 3: MORPHOLOGICAL CHART FOR A BEVERAGE CONTAINER
(Dym and Little, 2004)

Means Feature/Function	1	2	3	4	5	6
Contain Beverage	Can	Bottle	Bag	Box		
Material for Drink Container	Aluminum	Plastic	Glass	Waxed cardboard	Lined cardboard	Mylar films
Mechanism to Provide Access to Juice	Pull tab	Inserted straw	Twist top	Tear corner	Unfold container	
Display of Product Information	Shape of container	Labels	Color of material			
Sequence Manufacture of Juice Container	Concurrent	Serial				

C-Sketch Method

The C-sketch method is a way of generating ideas through visual thinking. In this method each member of the design group begins by sketching an idea on their own individual sheet of paper. After a brief period of time, these sketches are rotated to the next person in the group. The group members then work on the design in front of them, continuing to sketch as well as adding annotations. This process is repeated until the entire group has contributed to each of the sketches. Once this is done, the group discusses and records each of the design ideas.

Appendix C: Needs Assessment Data

TABLE 4: KING CHULALONGKORN HOSPITAL PATIENT SURVEY DATA

		Texture of the Food			Portion Size			Crockery Appearance			Cleanliness			Temperature		
		Poor	Neutral	Good	Poor	Neutral	Good	Poor	Neutral	Good	Poor	Neutral	Good	Poor	Neutral	Good
Ordinary	September	4.19	22.04	72.46	1.56	12.44	85.53	3.12	18.61	77.55	1.44	8.28	89.68	3.38	16.79	78.99
	October	4.52	20.29	73.84	1.22	11.26	87.15	1.96	17.03	80.64	0.61	6.50	92.89	3.74	18.06	77.09
	November	5.07	20.42	72.82	1.27	12.96	85.35	1.69	19.86	77.89	0.71	9.75	89.27	3.69	20.60	74.72
Special Diet	September	2.75	24.18	71.43	0.55	10.99	86.81	4.37	15.30	79.23	0.55	7.10	91.26	3.28	16.39	79.78
	October	4.40	19.78	74.18	1.10	8.79	89.01	3.85	13.19	81.87	1.65	5.49	92.31	3.91	12.85	82.12
	November	5.13	25.64	67.95	1.92	9.62	88.46	2.56	18.59	78.85	0.65	5.81	93.55	5.84	13.64	79.22
Liquid Diet	September	3.25	23.10	71.48	0.36	12.68	85.51	2.17	17.69	79.06	0.72	9.75	89.17	2.95	12.18	84.13
	October	5.12	23.23	69.29	1.96	11.76	84.31	3.16	17.79	77.47	1.57	7.09	90.16	5.12	12.99	79.53
	November	2.71	23.64	72.87	1.95	11.72	85.55	1.56	19.07	79.38	1.12	10.47	87.98	2.34	16.80	80.47
Low Bacteria Diet	September	23.52	41.18	35.29	11.76	17.65	70.59	17.65	23.53	58.82	0.00	5.88	94.12	11.76	29.41	58.82
	October	18.18	40.91	40.91	-----	31.82	68.18	-----	40.91	59.09	4.55	18.18	77.27	4.55	27.27	68.18
	November	31.25	37.50	31.25	6.25	31.25	62.50	18.75	31.25	50.00	12.50	18.75	68.75	13.33	13.33	73.33
American Food	September	0.00	25.00	75.00	0.00	16.67	83.33	0.00	25.00	75.00	0.00	8.33	91.67	16.67	16.67	66.67
	October	-----	-----	100.00	-----	-----	100.00	-----	-----	100.00	-----	-----	100.00	-----	-----	100.00
	November	-----	-----	100.00	-----	-----	100.00	14.29	-----	85.71	-----	-----	100.00	-----	-----	100.00
*	September	4.76	23.81	61.90	0.00	9.52	80.95	0.00	24.39	65.85	0.00	11.90	80.95	2.38	21.43	69.05
	October	4.08	12.24	63.27	0.00	4.26	78.72	4.26	10.64	70.21	2.04	4.08	79.59	2.04	12.24	71.43
	November	3.85	11.54	73.08	0.00	11.54	84.62	0.00	11.54	84.62	0.00	3.85	92.31	0.00	11.54	84.62

* When translating the survey, the person assisting us had trouble translating this term into English, therefore the name was omitted.

----- No Patients responded in this manner

TABLE 5: KING CHULALONGKORN HOSPITAL PATIENT SURVEY DATA CONT'D

		Meal Time								
		Breakfast			Lunch			Dinner		
		Early	Just Fine	Late	Early	Just Fine	Late	Early	Just Fine	Late
Ordinary	September	1.56	87.52	10.92	2.30	96.61	1.09	12.76	85.20	2.05
	October	1.23	87.71	11.06	1.36	97.77	0.87	11.94	85.45	2.61
	November	1.56	88.53	9.92	0.71	97.86	1.43	10.11	86.61	3.28
Special Diet	September	0.56	87.15	12.29	0.00	97.73	2.27	12.43	84.75	2.82
	October	0.57	86.36	13.07	1.14	96.02	2.84	9.71	86.86	3.43
	November	-----	88.74	11.26	0.67	98.00	1.33	8.00	88.67	3.33
Liquid Diet	September	1.47	89.38	9.16	3.38	95.86	0.75	8.99	89.14	1.87
	October	1.20	90.00	8.80	3.25	94.72	2.03	5.69	89.02	5.28
	November	1.94	89.15	8.91	1.18	97.64	1.18	9.41	87.84	2.75
Low Bacteria Diet	September	6.25	68.75	25.00	0.00	100.00	0.00	18.75	81.25	0.00
	October	4.55	77.27	18.18	-----	100.00	-----	18.18	81.82	-----
	November	6.25	75.00	18.75	12.50	87.50	-----	37.50	62.50	-----
American Food	September	0.00	91.67	8.33	0.00	8.33	91.67	25.00	75.00	0.00
	October	-----	50.00	50.00	-----	100.00	-----	-----	100.00	-----
	November	-----	100.00	-----	16.67	83.33	-----	-----	100.00	-----
*	September	0.00	87.80	12.20	0.00	100.00	0.00	9.76	90.24	0.00
	October	0.00	82.50	17.50	0.00	100.00	0.00	2.56	94.87	2.56
	November	0.00	96.00	4.00	0.00	100.00	100.00	4.17	95.82	0.00

* When translating the survey, the person assisting us had trouble translating this term into English, therefore the name was omitted.

----- No Patients responded in this manner

Information Gathered During Interviews and Observational Studies

Sponsor Input

- Trolley is damaging the walls of the centre
- Trolley is a health concern to the workers pushing them
- The use of cling wrap to seal the dishes is not environmentally friendly

Sponsor Expectations:

- The trolley will not damage the walls
- Trolley will be capable of being used without being a safety concern
- Ideally she would like to have a more environmentally method than cling wrap

Trolley Operator Input:

- The size and weight of the trolley as well as its poor wheels make it hard to control and maneuver
- The trolley operators have to wash the dishes that are served to the patients by hand on the patient wards
- The back wheel either gets in the way of the operator or must be turned under the trolley, which makes the trolley unstable
- The trolley operators like the idea of a brake, but the current one used on some trolleys is uncomfortable to use
- The size of the trolley makes it very difficult to see around
- People hear the bell but don't get out of the way of the trolley which makes it hard to navigate the busy walkways
- The doors on the trolley stick and are difficult to open and close
- Hinged doors would be easier to clean

Trolley Operator Expectations:

- Trolley will allow the operators to push it from an ergonomically correct position
- Trolley would be safe for them to use
- Trolley will be capable of holding cleaning solution, a towel, and the operator's apron
- The trolley will be easy to clean
- All containers for food will be fairly simple such that they can be easily washed by hand
- The trolley will have a braking system which can be engaged while the trolley is in motion
- The trolley will have a device on board which allows the operator to warn people that the trolley is coming even if they are not able to see it
- The trolley will allow them easy access the food

Kitchen Management Input:

- They have heard some complaints from patients about the food not being warm enough
- The customer service of the maker of the current trolley has been poor, which has made them difficult to maintain
- They would like the trolley made out of stainless steel

- The current doors sometimes fall off of their runners when the trolley goes over a bump

Kitchen Management expectations:

- Trolley must be capable of holding 32 plated meals
- Trolley will also be capable of holding large containers of bulk meals
- The trolley will be simply designed and easy to be cleaned
- The trolley will have a device on board which allows the operator to warn people that the trolley is coming even if they are not able to see it
- The trolley must be easy to maintain or there must be someone who can fix them if necessary

Data from Observational Studies at Chulalongkorn Memorial Hospital

- The current trolley is hard to maneuver because of its size, weight, and poor wheels
- The current trolley is too tall to allow adequate visibility
- The trolley is awkward and likely uncomfortable for the operator to push
- The trolley needs to be capable of transporting a mixture of plated meals as well as large pots and stacked trays for serving some meals on the patient wards
- The trolley needs to be able to travel over some uneven ground and over a sewer grate with slots in it

Data from Observations and Interviews at Bangkok Nursing Home and Bumrungrad Hospital:

- The system at BNH was very different from the one used at the Centre, thus their trolleys or ones similar to them would not fit the needs of the Centre
- The trolleys Bumrungrad uses are very similar and have many of the same issues that the Centre's do such as damaging the wall, them being heavy, and not allowing much visibility
- The trolleys at both hospitals used doors which opened out. This seemed to work well for them, except Bumrungrad had issues with some of their latches that held the doors closed
- Despite the fact that the kitchen at Bumrungrad was quite busy, the manager informed us that their outward swinging doors had not presented any safety issues nor had they had any instances of the doors being damaged by people or trolleys colliding with them.

Patient Feedback:

- A majority of the patients thought that the temperature of the food being provided by the trolleys was good. (The one group which was not nearly as satisfied were those patients receiving low bacteria food)
- A majority of the patients thought the appearance of the dishes their food was served in was good (The one group which was not nearly as satisfied were those patients receiving low bacteria food)
- A majority of the patients thought that the texture of the food being provided by the trolleys was good. (The one group which was not nearly as satisfied were those patients receiving low bacteria food)
- A majority of the patients thought that the cleanliness of the food being provided by the trolleys was good. (The one group which was not nearly as satisfied were those patients receiving low bacteria food)

Feedback from Design Discussions

Operators

- Another containment rack on the top of the trolley would help with enclosing smaller items that a bar at the current height would not restrain.
- They were hesitant about the trolley needing to have improved bumpers.
- Liked the hinged doors because they are easier to clean than the sliding doors
- They liked the idea of smaller wheels but thought that eight inch wheels might be too small. We were not certain if their reaction might have been caused in part by the fact that the trolley model did not make it clear that the wheels were inflatable. We tried to explain to the trolley operators that the wheels were inflatable and not hard castor wheels, but we are not certain they understood.

Management

- They agreed with the overall trolley design
- They felt that the trolleys needed to have improved bumpers like the design entailed
- They were hesitant about the removable insert because they did not think that there would be enough room in the trolley to hold bulk meals because there are often 20-30 meals in the trolley.

Dimensions and Shapes of Food Items

TABLE 6: FOOD CONTAINER DIMENSIONS

Item	Basic Shape	Length	Width	Height
Large Bulk Food Container	Cylinder	15"	15"	7"
Small Bulk Food Container	Cylinder	12"	12"	5 1/2"
Trays for Bulk Food	Circle	12"	12"	1" alone and about 1/8" when stacked
Bin for Liquid Meals	Cube	20"	15 3/8"	6.5"
Pale for Garbage	Cylinder	12"	12"	11"

Appendix D: Our Group's Brainstorming

TABLE 7: OUR TEAM'S WHY-WHY DIAGRAM (CHART):

Problem	Why	Why	Why		
Delivery system is inadequate	Not user-friendly	Can't store cleaning supplies			
		Doors are hard to open			
	Not Environmentally friendly	Food containers require a large amount cellophane wrap			
	Unsafe	People don't move out of the way of the trolley		They can't see the trolley	
				They don't want to get out of the way	
		Hard to push		Trolley is heavy	
				Trolley's wheel wobble	
				There is a large amount of friction in the wheels	
				The trolley travels over bumpy ground	
				Trolley has to travel over gradients	
		Limited visibility		Trolley sits too high off the ground	
			Wheels on the trolley are too large		
			Operators are short		
	Trolley is to large		Trolley is bigger than necessary		
			Trolley has to hold a large amount of food		
	Hard to stop	Trolley doesn't have adequate braking			
		Trolley is too heavy			
Large turning radius	Trolley is large				
	Wheels are insufficient				
Damages the walls	Walls aren't adequately protected				
	Current bumpers are ineffective		Material leaves marks		
			Bumpers are poorly positioned		
	Lack of bumpers				
Difficult to maneuver					

The Why-Why Diagram our group constructed was our initial brainstorming method. It allowed us to analyze every aspect of the problem and determine what areas possibly need to be addressed in the new trolley. Although most Why-Why diagrams appear to be of a flow chart, this was developed by our team for size purposes, and has the same outcome.

TABLE 8: OUR TEAM'S INITIAL MORPHOLOGICAL CHART:

	1	2	3	4	5	6	7	8	9	10	11	12
Food Containers	Closeable dishes	Cling Wrap	Insulated dishes	Boxes	Cafeteria Trolley	Trays					Food in the bag	
Transport Food	Caster wheels	Omni wheels	Rubber wheel	Inflatable wheels	Hard plastic wheels	Shopping cart puller	Ball wheel			"Hamster" wheel	Hovercraft	Tracks
Access to Food	Sliding doors	No door	"Hinged" doors	Garage doors	Accordion doors						Sliding compartment	Reach in the top
Maintain Suitable Temperature	Insulated dishes	Insulated trolley	Heated trolley	Styrofoam used as insulation	Microwave on the patient floors	Heat source in trolley	Heat the trays					Eliminate the food which needs to be heated
Prevent Damage	Bumpers	Corner guards on wall	Material trolley is made out of	Floor guard 'rail' around whole building	Bumper - rubber	Bumper - Cloth material	Bumper - Non marking plastic					
Stopping	Hand brake	Person stopping	Friction Brake	Rough surface on the incline	Foot brake						Hydraulic	Pneumatic
Allow Visibility	Make shorter trolley	Warp-around trolley	Horse-shoe trolley	Mirrors (on trolley and/or hospital walkways)	Center person on trolley	Make the trolley narrow	Clear trolley		Periscope	TV camera "reverse guard on cars"	Bike seat	Make the trolley operators taller
Storage Space Cleaning Supplies	"Added" space	"Built in" space	Movable compartment	Box on top	Box on bottom	Fanny packs	Cleaning supplies on patient floors					
Hold Food	Runners	Stack on top of each other	Individual Compartments									

Our group's initial Morphological Chart, shown in Table 8, allowed us to inspect each area that we identified had the potential to be improved through the new food trolley. The boxes that are highlighted in "green" are areas which our group felt were plausible ideas, and we researched those further. The "gray" colored boxes were initially brainstormed, but were quickly determined to be implausible for various reasons, some include: lack of expertise in field, financial constraints, and not a plausible solution.

TABLE 9: OUR TEAM'S MODIFIED MORPHOLOGICAL CHART:

Functions	1	2	3	4
Food Containers	Closeable reusable dishes	Cling Wrap	Closeable large serving containers	Reusable containers with one time use lids
Capable of Moving Food	Fixed castor wheels with shocks	Swivel castor wheels with shocks	Swivel inflatable tires	Fixed inflatable tires
Hold and Provide Access to Food	Purchase "off the shelf" trolley	Custom trolley made by trolley manufacturer	Trolley constructed by several companies with various skills/expertise	Modify currently used trolley
Prevent Damage to Facility	Bumpers	Corner guards on wall		
Stopping	Linear pull brake	Cantilever brake	Disk brake	
Remain in Place	Wheel lock	Brake engaged until operator disengages it		
Storage Space for Cleaning Supplies	Put storage box below handles	Build storage box into compartment down by the wheels	Put storage box above handles	

In our group's modified morphological chart we have eliminated many of the preliminary ideas because we found that they were either not feasible to be completed or they were not one of the top options for our group to consider. The items seen in Table 9 were even further researched by our group and were discussed with the different stakeholders at the Queen Sirikit Centre for Breast Cancer until we reduced this list to the components of our custom made trolley.

Appendix E: Manufacturer's Contact Information

TABLE 10: MANUFACTURER'S CONTACT INFORMATION

Manufacturer	Specialty	Location	Contact Name	Position	Telephone Number	Email Address
Thai Trolleys	Trolleys	Thailand	Pitsamai Tiyaubutr		849132287	mai188@hotmail.com
D4 Surgicals	Trolleys	India	Sachet Mahajan	CEO		exports@d4surgicals.com
Dreissen	Trolleys	Thailand	Mr. Winit Maidee	Sales Engineer	66 23303002-6	Winit.Maidee@driessen.com
Everest Equipment	Trolleys	India	Anil Sharma		9990337355	everestequipment@gmail.com
CRHouseware	Trolleys	Thailand	Klang Krua Rean			crhouseware@gmail.com
<i>Heme Medi Dianafit</i>	Trolleys	India				
Cambro	Trolleys	USA			(714) 848-1555	lbowman@cambro.com
Innovation Step Co., LTD	Trolleys	Thailand	Mrs. Spai Hirunwiboon	Overseas Coordinator	02-5918671-2	smilecar@asianet.co.th
Temp-rite	Trolleys		Mr. Michael Le Clerq	Managing Director		secretary@temp-rite.nl
Phitphisarn	Corner Guards	Thailand	Wirat		081-702-6730	
Thermobox	Dishware	United Kingdom				
<i>Superware</i>	Dishware	Thailand				
<i>Two Thousand Supply Co., LTD</i>	Wheels					
<i>Super Wheel</i>	Wheels					
Caster & Wheel	Wheels	Singapore	Kathleen Tham		65-67456944	tham@castorwheel.com
Rhino Caster	Wheels	Thailand				kriangsak@thaicastorwheel.com
<i>DJ Products</i>	Trolley Pusher	USA				
<i>Probike</i>	Brakes					
<i>Saengthong</i>	Brakes					
<i>ThaiCannasia</i>	Brakes					

* If a field is left blank our group was not able to obtain that information. The companies in italics are those who never returned our attempts at contacting them; those in green are the ones that we recommend for the Centre's use.

แผนที่บริษัท ออฟฟิศไทย ออนไลน์ จำกัด
โทร 02 7556141-2

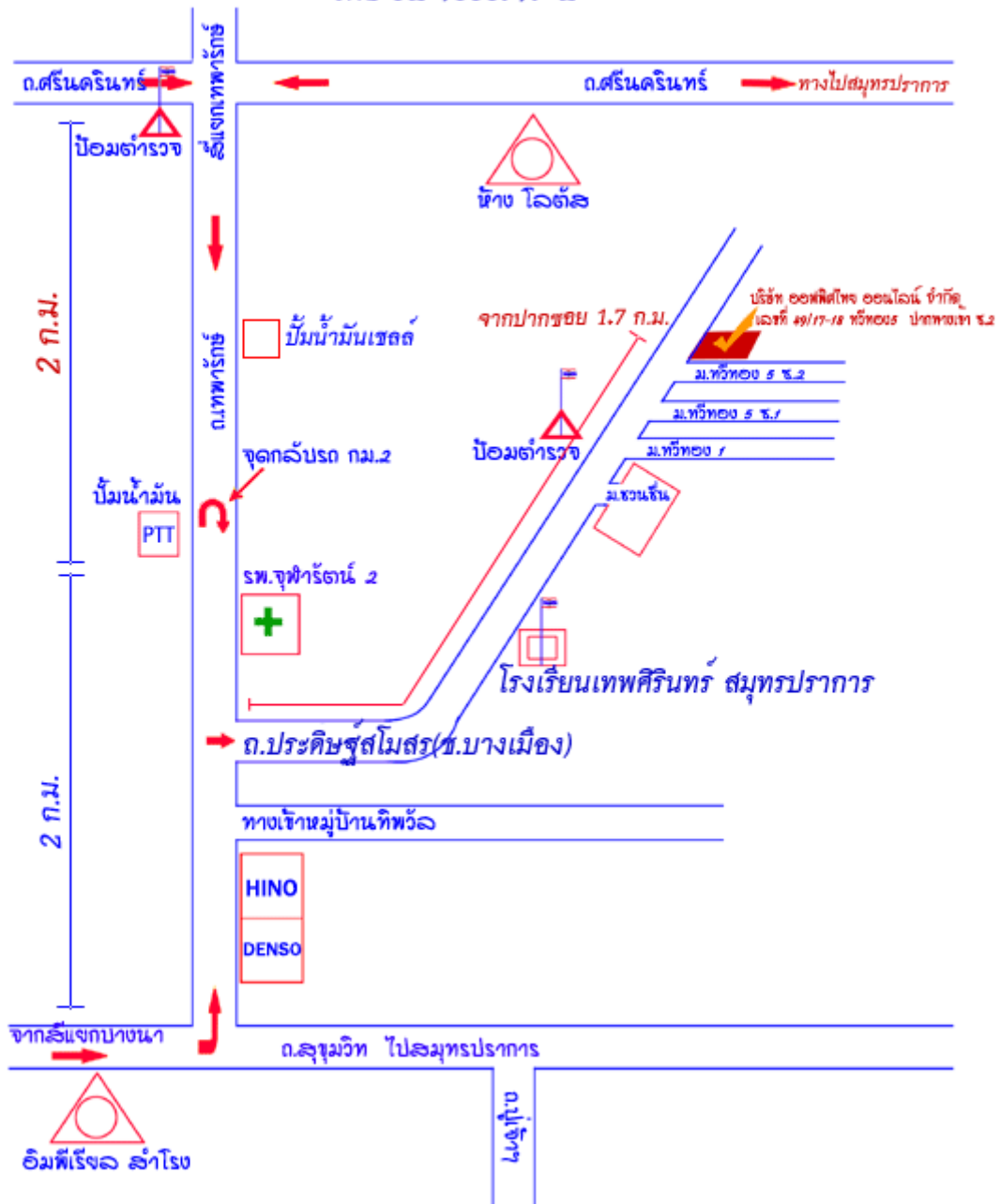


Figure 32: Map of Where Thai Trolleys is Located

Appendix F: Engineering Drawings of Custom Trolley

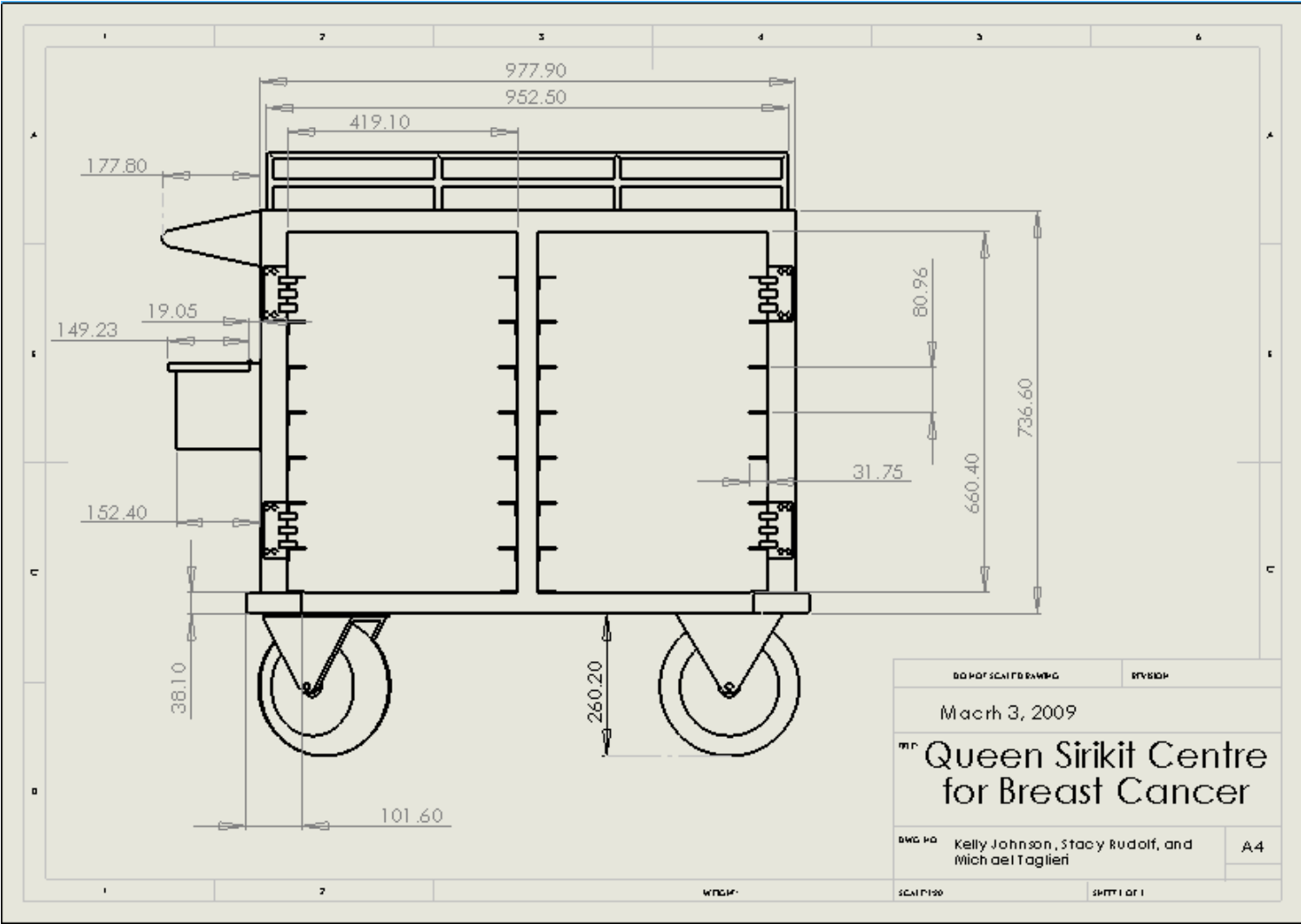


Figure 33: Engineering Drawing of Custom Trolley: Front View

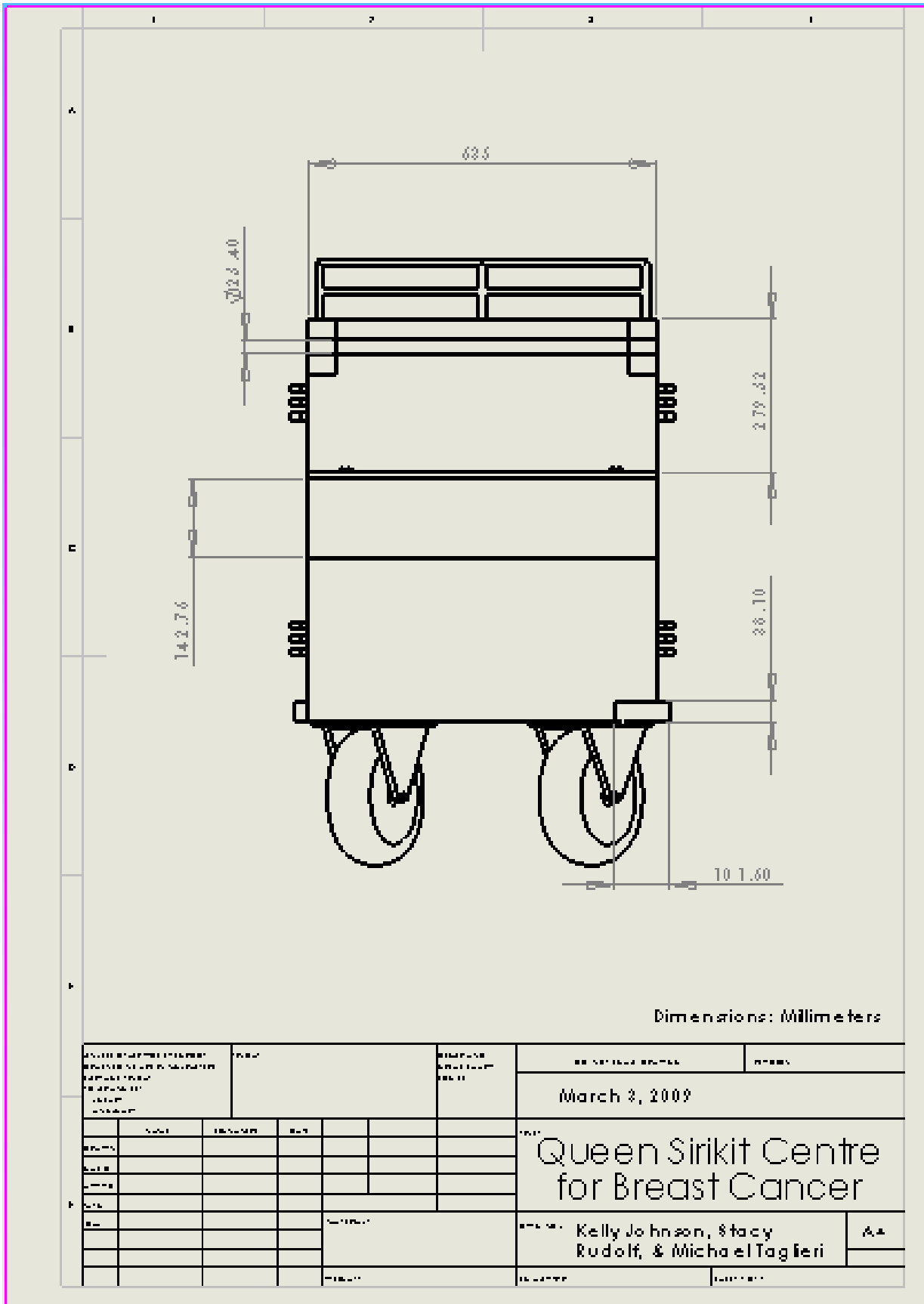


Figure 34: Engineering Drawing of Custom Trolley: Left View

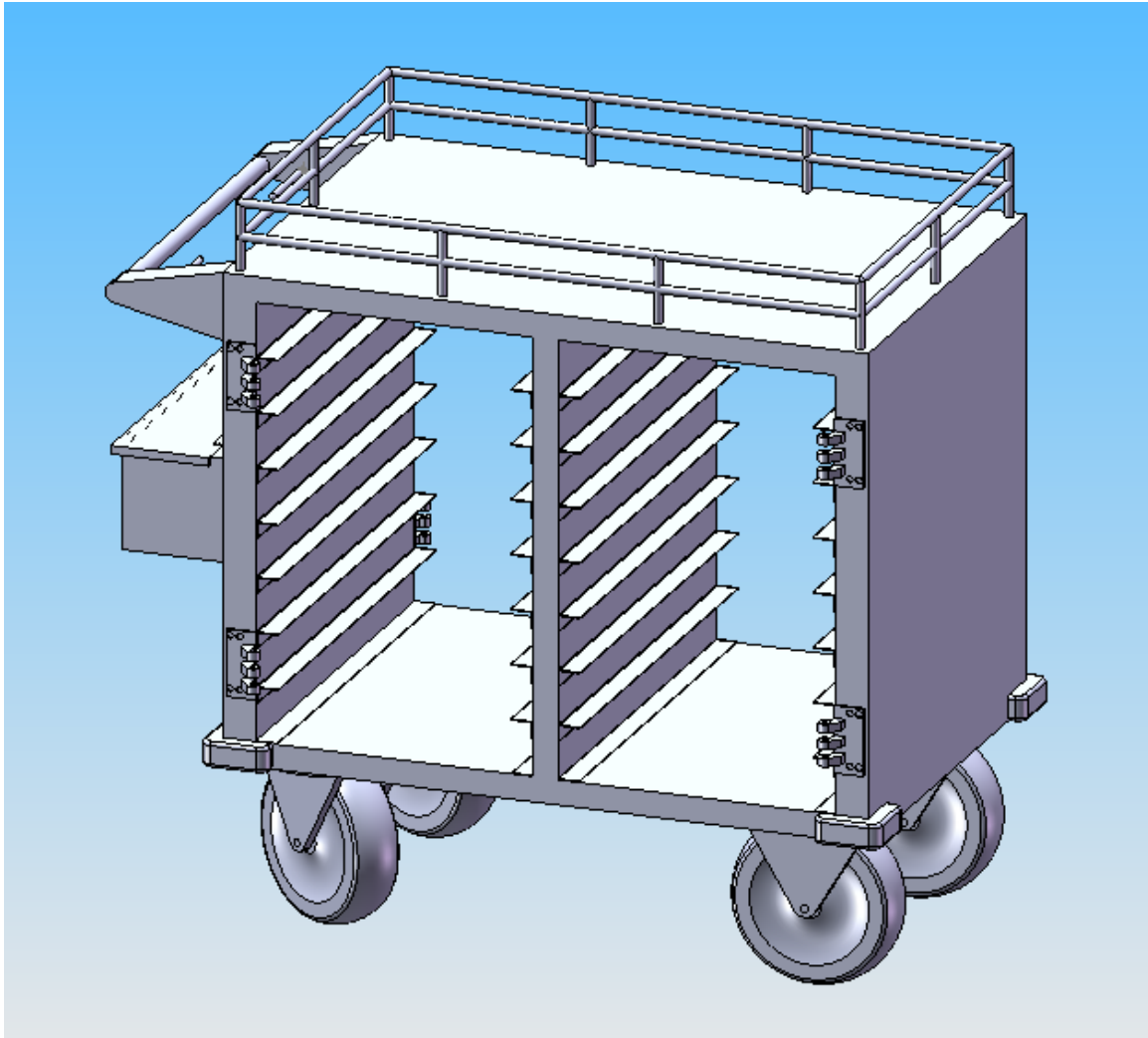


Figure 35: Engineering Drawing of Custom Trolley: Isometric View

* The doors are not included in our custom trolley because our group allowed Thai Trolleys the ability to pick whichever doors they felt would best serve the Centre. The Hinges were left on the drawing to depict to the viewer that this trolley would use doors. Also, the brake handles depicted in this drawing could change depending on the manufacturer's recommendations.

Appendix G: Preliminary Analysis of Cling Wrap vs. Reusable Containers

Our team sought to analyze the environmental and financial efficiency of the current method of containing the food used at the Centre. We suspect that the use of reusable re-sealable containers might be a better option for the Centre, but due to time constraints, we were not able to complete research on the containers. The following is our preliminary analysis.

The Environmental Impact:

Khunying Finola made our team aware of the large amount of waste the current system produces. Most dishes are covered with what we believe is PVC cling wrap, an environmentally harmful product. Thus, we set out to determine the environmental impact of cling wrap vs. an alternative solution, reusable containers. However, our group did not have the time necessary to complete a thorough analysis of the two methods. We recommend that further analysis be done to determine the environmental impact of the cling wrap and reusable containers. The following is an example of all of the areas which would need to be analyzed.

- Process used to produce the material
- Manufacturing process of the product
- Product Packaging
- Shipment method/distance
- Processes used to maintain the product
- Processes used to discard the product

Each of these steps could be different depending on the product used, and they would each need to be analyzed before the environmental impact of each of the product could be compared.

Financial Considerations:

We set out to determine whether the currently used system of plating meals is more or less expensive than a new system which would involve reusable containers. Our group compared the price of one dish in the current system to one reusable container over their expected lifespan. We set the following inequality to determine the answer:

$$(\text{Price of the current dish} + \text{the price of the cling wrap per dish}) \begin{matrix} < \\ > \end{matrix} ? \text{ Price of the reusable container}$$

To determine each of these values we used the following calculations and assumptions:

Each plate requires a square of cling wrap measuring 35cm × 35cm

Based off of a price estimate from MMP Corporation, a distributor of the cling wrap used at the Centre, a roll of cling wrap which measures 35cm × 500m (50,000cm) would cost 415 baht

Therefore:

1 roll of cling wrap could supply 1 dish the necessary cling wrap for 1,400 uses

$$\frac{35\text{cm} \times 50,000\text{cm}}{35\text{cm} \times 35\text{cm}} \cong 1,400$$

Further:

1 dish is used for approximately 2,190 meals before being discarded

$$365 \text{ days in the year} \times 3 \text{ meals a day} \times 2 \text{ years of use} = 2,190$$

Thus:

Every plate uses 1.56 rolls of 35cm × 500m cling wrap in its lifetime

$$\frac{2,190 \text{ meals}}{1,400 \text{ uses}} \cong 1.56$$

Finally:

Every plate uses approximately 650 baht worth of cling wrap over its lifetime

$$1.56 \text{ rolls} \times 415 \text{ baht} \cong 650$$

Unknowns:

The price of the currently used dishes
The price of the reusable containers¹

In Conclusion:

Once the Centre determines the prices of the currently used containers and the reusable containers, they will be able to determine which of these options would be more financially beneficial.

$$(\text{Price of the current dish} + 650 \text{ baht}) \begin{matrix} < \\ > \end{matrix} ? \text{ Price of the reusable container}$$

¹ Negotiations with supplies have not progressed that far

Appendix H: Dimensions and Calculations of Trolley Sizes

The following calculations were used to determine the difference in volume, surface area, and weight of the current trolley vs. the new one. Also, we used various calculations to confirm that the amount of surface area remaining on the top of the trolley was sufficient to hold the necessary potted meals.

Table 11 illustrates the dimensions of the Current used trolley and the newly designed trolley:

TABLE 11: TROLLEY DIMENSIONS

	Current Trolley Body (inch)	New Trolley Body (inch)
Length	43 ³ / ₈	39
Width	29 ⁵ / ₈	25
Height	28	29
Overall Height	46 ¹ / ₂	38
Volume of Trolley	35,979 in ³	28,275 in ³

The volume of the trolley was calculated by multiplying the length, width, and height of the trolley together:

$$\begin{aligned} \text{Currently Used Trolley:} & \quad 43.375 \text{ in} \times 29.625 \text{ in} \times 28 \text{ in} \cong 35,979 \text{ in}^3 \\ \text{New Trolley:} & \quad 39 \text{ in} \times 25 \text{ in} \times 29 \text{ in} \cong 28,275 \text{ in}^3 \end{aligned}$$

The decreased surface area was calculated using the following formulas:

$$2 \times 4.625 \text{ in} \times 39 \text{ in} = 360.75 \text{ in}^2$$

$$2 \times 4.625 \text{ in} \times 28 \text{ in} = 259 \text{ in}^2$$

$$2 \times 4.375 \text{ in} \times 28 \text{ in} = 245 \text{ in}^2$$

$$2 \times 4.375 \text{ in} \times 29.625 \text{ in} = 259 \text{ in}^2$$

$$2 \times 1 \text{ in} \times 25 \text{ in} = 50 \text{ in}^2$$

$$2 \times 1in \times 39 = 78in^2$$

$$360.75in^2 + 259in^2 + 245in^2 + 259in^2 - 50in^2 - 78in^2 = 995.75in^2$$

The surface area of the top of the trolley is calculated by multiplying the length and width together:

Currently Used Trolley:	$43.375in \times 29.625in \cong 1,285in^2$
New Trolley:	$39in \times 25in \cong 975in^2$

Surface area required:

Large Pot:	$\pi \times (7.5in)^2 \cong 177in^2$
Small Pot:	$\pi \times (6in)^2 \cong 113in^2$
Liquid Meals Bin:	$20in \times 15 \frac{3}{8}in \cong 307.5in^2$

$$(2 \times 177in^2) + (2 \times 113in^2) + 307.5in^2 = 887.5in^2$$

$$887.5in^2 < 975in^2$$

* Our group determined that the maximum amount of potted meals placed on top of the trolley would be two large pots, two small pots, and one bin for the liquid meals. This was determined through observational studies.

Appendix I: Timeline of Project

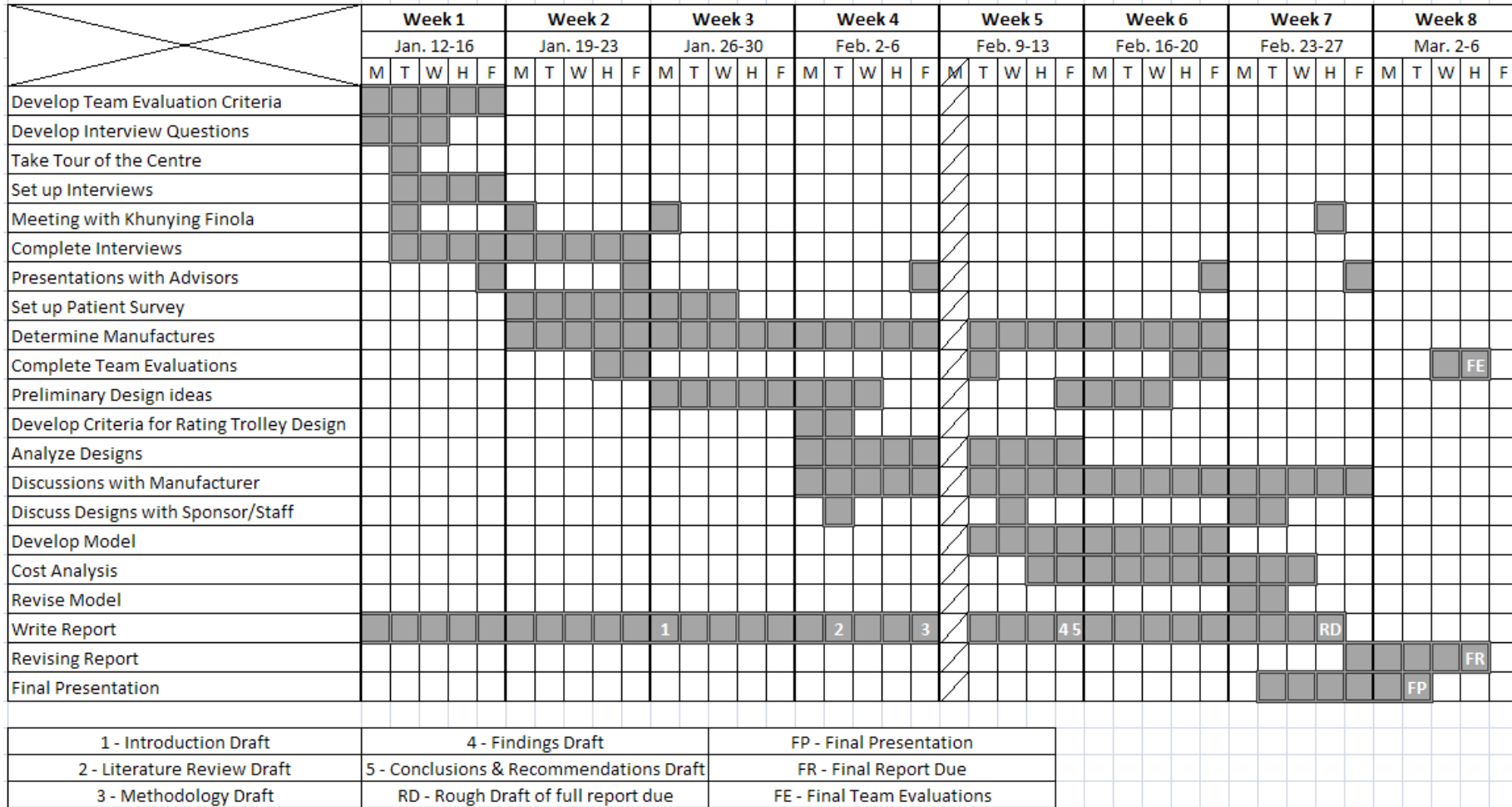


Figure 36: Our Team's Timeline for the Project

Appendix J: Team Assessment

In order to assist our team in working effectively on our project and aid our learning about teamwork we conducted bi-weekly team assessments throughout our time in Bangkok. In these team assessments we individually identified strengths and areas of improvement for each group member as well as the team as a whole. We discussed these areas along with recommended methods of improvement in a bi-weekly group meetings held after we each filled out the assessments. The assessments shown in this appendix are the final summative assessments that each team member filled out about themselves and the team as a whole.

Kelly Johnson's Team Assessment:

Entire Team Assessment: Food Trolley Team Assessment Filled out By: Kelly Johnson

Our group successfully identified and adhered to processes that allowed us to work effectively. At the beginning of the term we developed a team contract that outlined several key factors to our success. Every morning we sat down and created a list of tasks for the day and a plan for completing them. On Mondays we also developed goals for the week. These two tasks allowed us to keep in mind the long term goals we wanted to complete as well as the individual tasks that would contribute to achieving them. We also determined that we would set fairly strict internal deadlines for our work. We did not always adhere to initial deadlines because factors outside of our control affected the progress of the project, but we readjusted our initial deadlines if necessary and met all of our final deadlines which helped us to stay on task with the project and finish the writing in a timely fashion.

In the beginning of the project, we did not specifically discuss what practices we should follow to ensure that we worked respectfully because we had not had any issues with respect during our preparation work before arriving in Bangkok. However, during the term we used our team assessments to discuss issues that arose pertaining to respect and adopt practices that fostered a respectful environment. During one of our team assessments we discussed how we often had a habit of interrupting each other. Although it had not yet become an issue, we discussed how interrupting someone could be perceived as having a lack of respect for that person. Thus, we determined that we should not interrupt each other. In order to make ourselves more aware of the practice and to change our habits we deemed it appropriate for someone to state when they had been interrupted and continue on with what they were initially saying. After the team assessment our interrupting decreased significantly. Although we will still sometimes interrupt each other, we usually become aware of what we have done, apologize, and ask the original speaker to continue.

Although we functioned well as a team, there were times during the term that we became frustrated with each other and stressed about the project. Through our open communication and the aid of our team assessment we were able to identify and discuss problems as well as methods for solving them. One of the main adjustments we made was with our editing method. Part way through the term we determined that the editing method was frustrating several of the team members. They felt that their time was being wasted because the process took a long time, during which not everyone was actively editing. We developed a new method of editing that would allow the team members to work at the pace that best suited them. We then tried it out to see if it alleviated people's frustrations while still producing quality writing and it worked so we continued to use it throughout the rest of the term.

Another issue that we struggled through throughout the term was balancing teammates' expectations. We all wanted to produce a well developed solution for our sponsor and a thorough report. However, our opinions of how much time and effort should be put into the work differed especially because we only had a limited time to experience and enjoy Thailand. As the term progressed we discussed this issue and established some guidelines as to how we would spend our time and what priorities would take precedence when. However, looking back on the experience it would have been beneficial to discuss each other's expectations both about the project and our time in Thailand more thoroughly at the beginning of the project. This would have allowed us to understand where each teammate was coming from and develop a work plan that corresponded with what we wanted to achieve overall out of our experience in Thailand.

Individual Team Assessment: Kelly Johnson
Assessment Filled out By: Kelly Johnson

I (Kelly) believe that I put a lot of effort into the project and produced high quality results in the time frame my teammates expected. On the sections of the report that I was responsible for writing and editing, I put the time and effort in to ensure that I not only completed the necessary work by the time we had decided to have it completed, but also fully developed the writing so that it was the best work that I could provide. I also contributed significantly to the design process as well as interviews and researching manufacturers. In the positive attributes section of our team assessments my teammates wrote that I had a "no-quit" attitude, was always on task, and produced a lot of work.

Although I was not always able to completely correct my flaws, I was always open to my teammates and advisors feedback about my actions. I carefully considered their input as well as their recommendations for how I could improve my behavior. One area I was approached about and was able to address was becoming more comfortable with talking to people outside the group. Throughout the rest of the term I volunteered regularly to meet with the kitchen management and the trolley operators to gather their feedback about the design. As the term progressed I became more comfortable with approaching people and asking for their input and help with our project. I even asked a Chula student I did not know to help us with translating to street vendors so we could ask them about the manufacturers of their carts. One issue that caused my teammates frustration was my perfectionism. This was discussed several times in our team assessments and was an issue that I was unable to completely address. However, I did feel as though by the end of the term I was more aware of my actions and that I did a better job distinguishing between whether or not something was important enough to warrant any extra attention.

Although my assessment of my weaknesses did not always align with my teammates, I was typically able to look at my actions from my group members perspectives and identify issues that might be frustrating to them. One such behavior was me being overly involved in all aspects of the project. I identified this issue in the beginning of the term and although I was not able to quickly address it, as was evident in the issue reappearing later in the term in my teammates' assessment of me, I felt that by the end of the term my behavior had improved. I was conscious of the issue and actively tried to curb my tendencies away from becoming overly involved. One of the ways our group addressed this issue was to discuss what we expected of things before they were done. For example we discussed what information we wanted to obtain from the kitchen staff and potential manufacturers before we sent any team members to meet or call them. By the end of the term I trusted my teammates

enough to be comfortable with Mike meeting with the manufacturer to purchase the trolley alone and Stacy doing the final edit of our paper.

Through the use of our team assessments I was able to discuss my feelings about our team as a whole as well as our individual actions. I feel that I provided my teammates with thoughtful feedback and recommendations that would help them to improve. An example of this was in the beginning of the term when I felt that Stacy was not contributing as much as she could to the group's brainstorming efforts. I recognized that this was probably caused by apprehension she had about the design process and offering up ideas that might be rejected. I suggested that we try and make sure that Stacy was comfortable with the idea generating exercises we were going to use and that we practiced good brainstorming etiquette so that we would all feel comfortable offering ideas. Although I am sure it was not simply a reflection of my feedback, after that discussion it appeared that Stacy felt comfortable enough to provide more ideas.

Stacy Rudolf's Team Assessment:

Entire Team Assessment: Food Trolley Team Assessment Filled out By: Stacy Rudolf

I feel that we functioned well as a team. We each had different strengths, and we worked utilize these strengths and also help each other to build on our weaknesses. To effectively communicate how each group member and our team as a whole could improve, we completed team assessments. We used these assessments to convey our feelings, frustrations, areas of weakness, and also our successes.

As a team, we had a balance of teammates that looked at the larger picture to be sure that we focused on the aspects of the project that would make a difference in the final project and teammates that paid close attention to detail to be sure that we didn't overlook something that might be important. We were able to discuss different aspects as a team to determine their importance. No idea was too insignificant to be dropped without a discussion, and we respected each other's ideas. An example of a method we used to decide the importance of things is evident in our editing technique. We recognized that we were spending too much time debating the wording of our paper. To address this issue, we determined that if three minutes passed and we had not arrived at a consensus, we would step back and look at the overall importance of the change. If it was not important, we moved on to keep our team and project moving forward.

As the term progressed, the environment was more tense as deadlines approached. There were times when our team was frustrated with each other. However, we did not start saying disrespectful things to each other, and conducted ourselves professionally towards each other in spite of emotions. We also looked for the root cause of the frustrations. For example, in an attempt to complete the best project possible, we were putting a full day's work into the project, often from 6:30 AM to 11:00 PM with a short break for lunch, dinner, and possibly a short activity. However, we recognized that this approach was not healthy for some of our teammates, and causing them to be tired, unfocused, and frustrated. To address the issue, we made sure that we worked hard for a specified time period, and then gave each other time to unwind and relax. To be sure that we still accomplished enough work, we made lists at the beginning of each day to lay out our goals for the day. Each team member would begin on a task, and when a certain task was completed the member could look to the list for the next task. At the end of the day, we split the remaining tasks among group members to ensure that everything was accomplished.

Further, as a team, we recognized the areas that individuals wished to improve themselves. For example, when the advisors commented that one group member should continue to expand upon her communication techniques to people outside of the group, we addressed the advice. When there were contacts to be made, we made sure that she had an opportunity to complete at least some of the phone calls. However, we did not expect her to make every phone call. Thus, we attempted to support her development without overwhelming her.

Our effective communication and attempts at improvement helped us develop as a team. By developing methods to recognize and address the various issues and behaviors that frustrated and upset each other, we were able to recognize how we should support each team member. I feel that we have completed a project that is better than any one or two of us could have. By analyzing each section of the project with at least two people, there is not any section that is entirely one person's work. The combination of our efforts allowed us to create a successful IQP project that will hopefully be able to help the Queen Sirikit Centre.

Individual Team Assessment: Stacy Rudolf
Assessment Filled out By: Stacy Rudolf

I (Stacy) feel that I have been an effective teammate. I completed all tasks asked of me in a timely fashion, and to the best of my ability. Further, I critically assessed others work to make sure that our project continued to improve. I contributed ideas for tasks that could better our project, and found new things to do myself to further the effort. As a teammate, I supported both Kelly and Mike. I made sure that they did not have more work than they could handle, and offered to help when possible. If they were trying to do something outside of their comfort zone, I tried to support them and offer suggestions for further improvement.

As I tried to help them, Kelly and Mike, as well as the advisors, tried to improve my effectiveness as a team member. I worked to accept the critique with an open mind. In the first few weeks of the project, Kelly suggested that I try to be more involved with the design process even though I was not as experienced with it. In the weeks that followed, I tried to listen for when Kelly and Mike were discussing design aspects and provide my feedback. Although I could not express my ideas in technical terms, I was able to effectively communicate the general base of my ideas so that they could understand and use my ideas. For example, when discussing the wheels, I was not comfortable with the terms “castor,” “swivel”, and “omniwheel.” However, by using words that were in my vocabulary, I could communicate which type of wheel I felt would be best for the trolley.

From this project, I feel that I have grown as an individual. I was able to draw from Kelly and Mike’s strengths to improve my own work, and further contribute to the project in areas in which they were not as talented. From Kelly, I learned to pay more attention to details. I am more of a larger picture person, but if the small aspects are over looked, then the big picture can not be as complete. There were sometimes in the project where I would feel that we should skip certain steps, especially in the design process. However, by going through various brainstorming methods, we were able to identify different options for the trolley, such as that it may not need doors. In the future, I will make sure that if there is something that I notice may be important, I should take the time to really consider the implications of ignoring that aspect. I know that this will make my future work more credible and complete.

Mike’s confidence and ability to speak professionally to those outside our group has also helped me to grow. I am very uncomfortable asking for help when I do not have a clear understanding of the topic I am asking about. However, often times the reason we need to ask the question is because we don’t know enough about it. Mike was always willing to ask for help even when I was hesitant. His actions helped to keep our progress with the report moving and saved time when we may have been struggling to continue. As the project progressed, I tried to take more of the phone calls and interactions with people outside our group to further build my comfort zone. Although I sometimes made mistakes, the team still supported me and allowed me to grow in this respect. He helped me to realize that it’s ok to ask for help even if you haven’t fully developed as far as you can go without help for the sake of time.

Michael Taglieri's Assessments:

Entire Team Assessment: Food Trolley Team Assessment Filled out By: Michael Taglieri

In my opinion, our group was a highly functioning team that produced a large amount of high quality work. Our goal was accomplished in a timely fashion, while our group still paid attention to detail and documented our processes and findings in a well thought out and written report. To guarantee that our group would continue to not only excel throughout the term, but also improve on our accomplishments, our team members were able to offer constructive criticism in our bi-weekly team assessments.

These team assessments allowed our group to offer constructive criticism to every team member while also commenting on the positive aspects which they brought to our group. By completing these team assessments for each member as well as critiquing yourself it allowed each member to critically think about what they needed to work on, but also what they were doing well and how they could continue to improve. An example of this process working well was our group adjusting the way in which we edited to account for each individual person's editing skill and time necessary to complete it. The new method was very successful and allowed our group to be more productive with each person's time. Not only were team assessments helpful, but our team was honest with each other throughout the week which allowed us to discuss issues informally if they arose at a time when a formal assessment was not taking place.

Additionally, our team was able to optimize each member's abilities to the best of our ability. My (Michael's) writing ability was not as strong as Kelly and Stacy's, so instead of writing large portions of the report, I (Michael) was able to use my other skills to benefit other areas of the project, such as designing the Food Trolley in SolidWorks (the computer program used to do this). Further, our group was able to work extremely productively at work. Our office did not have internet access which allowed our group to work with minimal distractions throughout a large portion of the day. Also, due to the scheduling of other workers, we left our office no later than 3PM every day which allowed our group to work on the internet if necessary from 3-5. This schedule allowed our group to complete large amounts of work in the morning while still completing the work requiring internet in the afternoon.

Although our group produced a high level of work and optimized many aspects of our team, there were some issues which arose throughout the term. Most of these issues were identified and fixed through open discussions occurring during team assessments or other conversations, such as our editing methods as discussed above. A very small amount of these issues were not able to be fixed during these discussions as they were conflicts in personalities which are more difficult to 'change'. The issues which did arise due to conflicts in personality were dealt with in professional manners by discussing ways in which these differences could be minimized. An example of a situation such as this is the amount of time which our group spent on the project during some weeks and how it affected sleep schedules. This was a fundamental disagreement within our group and could not be completely agreed upon. However, we were able to work through this disagreement and others like it by discussing it and arriving at solutions which each group member could understand and 'live with' even if they did not fully agree with.

Overall, our group worked very well with each other while producing very impressive results. We were faced with a variety of situations ranging from minor disagreements to the fundamental ones discussed above. Our group was able to work through these issues while completing an extremely impressive project and learning a lot in the process.

Individual Team Assessment: Michael Taglieri
Assessment Filled out By: Michael Taglieri

I (Michael) was a valuable member to our group and produced valuable deliverables to the group such as the computer models of our design as well as the formatting of the paper and developing many of the visual aids which can be seen in the paper. Additionally, I was able to assist with many of the processes to arrive at those deliverables. Interactions with the sponsor as well as the kitchen staff are a few examples of the assistance with the processes that I offered to the team.

Through the team assessment and feedback process I was able to identify weaknesses of mine through my self-evaluations as well as hear the feedback of my other team members. Although I was not able to completely address every issue, I was able to think about each issue in my daily activity and try to address it to the best of my ability. An example of this is: During the first week or two of the project I was having trouble staying on task after 3PM when we left our office because this change in working location interrupted my 'work flow', and there was internet access where we worked from 3-5PM. Through the team assessments and my personal analysis I was able to determine that the best way to approach this situation was to determine what needed to be done before leaving our office at 3PM and then only working with internet access if I needed it to complete my tasks. Additionally to reacting to feedback which my group members identified, I also was able to constructively give feedback to each of my team members. I was able to identify at least one and usually two areas for improvement every week while also highlighting many of their accomplishments. This was done so that team members could see areas to improve while still giving them confidence by stating their benefit to the team.

Some general areas of improvement for myself are to continue to improve on my writing abilities, communicate my thoughts to my group members and advisors as clearly and concisely as possible, and to always listen to ideas of other group members. Through the feedback that I was able to receive from group members as well as the feedback which I was able to give to each member coupled with my benefit to the team, I believe that I was an effective team member who positively contributed to the project.

Appendix K: Cultural Awareness Essays

The WPI-Bangkok Project Center provides students with a special opportunity to advance their intercultural awareness and competence. During the preparation period and on-site, students learn about general categories of cultural difference, specific aspects of Thai culture, and how to distinguish cultural stereotypes from appropriate generalizations. The essays in this Appendix use the Describe-Interpret-Evaluate (D-I-E) process for debriefing and analyzing cultural encounters in constructive ways. Recommended by intercultural learning and study abroad experts, this model guides learners to separate observable facts from interpretation and to delay judgment until multiple perspectives of the same events or behaviors have been identified and considered. By doing so they are more likely to be empathic and less likely to make incorrect interpretations and negative judgments that will limit their effectiveness when working internationally or domestically with people of different origins. Using this process can also help people manage the stress and frustration often felt in cross-cultural situations.

Kelly Johnson's:

A Shopping Trip in Thailand

The other day when I was shopping I approached a stand where a woman was selling shirts. Before I could get all the way to the stand she began asking which size I wanted. After a couple seconds hesitation I replied that I would like to look at a large and she handed me a large shirt to try on. She stood next to me as I put on the shirt over the one I was already wearing. I decided that it seemed like it might be a little larger than I was looking for so I asked to see a medium. I proceeded to try that one on in a similar manner; all the while she was standing right next to me. She commented that it was too small and I agreed as I hadn't been able to do up one of the buttons. She then began rifling through the stack of large shirts asking me which color I wanted. I stood there unresponsive for several seconds, trying to decide if I wanted to buy a shirt seeing as neither size had been exactly what I was looking for. I finally decided to ask if I could try on a large shirt again. She handed me one and I tried it on. Meanwhile she stood right next to me asking if I would like to buy it. I replied that I was not sure and took the shirt off. I stood there for a little while longer trying to reach a decision. Finally I thanked her, told her I was not interested, and walked away. I wandered around the other shops for a couple of minutes, not really looking at anything but rather trying to decide whether or not I wanted to go back and buy the large shirt. Finally, I decided to return to the stand and buy the shirt

There are several possibilities as to why the woman constantly stood over me while I was shopping and was quick to offer suggestions and to sell me the shirt. From an American

perspective I might say that her actions were aimed at improving her chances of selling the shirt through pressuring me to make an impulsive decision. From this angle it is easy to see how all of her questions and the fact she was standing over me guided me towards the end result of buying the shirt and left me little time to think through my choice.

However, by standing over me she may not have been intending to speed up my decision at all. Rather, she could have remained near me so that I would directly associate her with my decision. If that was the case she may have been thinking that it would be harder for me to refuse her requests and walk away from her, than it would have been to simply walk away from a display of shirts. Or, she might have been thinking that her standing there would remind me that her livelihood depended upon her selling shirts. Thus, I might feel a sense of guilt if I refused to purchase one.

It is certainly possible that her intentions were much more simple and less manipulative than those I have just discussed. From what I understand, shopping in Thai culture is typically more of a friendly social interaction between the buyer and the seller than it is in the United States. Thus, her questions and advice could simply have been her attempt at being helpful and aiding me in my shopping. If this was the case, the reason why she was standing near me might simply have been so that she could respond as soon as I needed so I would not be inconvenienced by digging for a shirt or locating her to make a purchase. Perhaps if I had been fluent in Thai, we would have carried on a conversation while I made up my decision, which would have made her standing next to me seem much more natural. She also could have been standing there as a manner of keeping her stand organized and tidy. Her positioning was such that she could intercept me before I put a poorly folded shirt back in the wrong spot. Her standing there also could have acted as a deterrent for shoplifters, although theft is a lot less common in Thailand than in the U.S. and may not be a large concern.

When I was interacting with the woman and trying to decide whether to purchase the shirt I felt rushed and flustered. I was uncomfortable with someone standing over me while I was trying to make up my mind. I like to think through my purchases and when she was asking questions, offering suggestions, and even just standing there, I felt that I did not have the time or space to think about what I wanted. I believe that these feelings stemmed mostly from the fact that a lot of the shopping that occurs in the U.S. is very impersonal. This is probably due in part to the abundance of large chain stores as well as the ability to purchase things over the internet, at both of which one can generally shop at their own pace without a sales person providing unasked for feedback or assistance. I feel that if I was a Thai person, I

would have been a lot more comfortable with the sort of shopping practices I experienced. For starters, if I was fluent in Thai, I would have been able to carry on a conversation with the woman, which most likely would have made her standing right next to me a lot less awkward. I also probably would have expected a shopping experience to include a friendly encounter with the woman which included a conversation and some good natured bartering. In that case, I might have felt slighted if she had shown any less attention to me.

Stacy Rudolf's:

Helpful Hesitations

In the work place, Khun Jieab, an administrative assistant, was assigned to care for our needs. She was very friendly and often brought us food and checked to see how we were doing. Our sponsor, Khunying Finola, told us that we could ask Khun Jieab any questions we wished. One day, while waiting for the elevator to go for lunch, we asked Khun Jieab if it would be possible for her to set up a meeting with the kitchen staff for us to interview them. At first, she looked concerned and puzzled, and I thought she might be upset by our request. Her reaction surprised me because I expected her to say yes or no immediately based on if she could complete the task. After about ten seconds she nodded her head and said “yes, I can do that.” We thanked her and continued to lunch. Throughout our stay in Thailand, Khun Jieab obliged all of our requests.

There are many reasons Khun Jieab could have hesitated and looked concerned when we asked her what we believed to be a simple question. As an American, when someone looks concerned and doesn't answer a request right away, I assume that they do not want to complete the task. Usually, the person is either deciding whether they have time to complete the task in their busy schedule, or trying to think of a way to say that they can not complete the task asked. This sort of a reaction corresponds to the value *Maximizing Study Abroad* defines as individualism because in this situation, the person would be considering how the request would affect his/her personal time.

A second thought may have been crossing Khun Jieab's mind. Most days, when we ask Khun Jieab how she is doing, she replies, “busy, busy, busy.” Because of her busy schedule, it could have been difficult for her to find time to complete our request. Rather than considering *if* she had time, as described before, she may have been considering only *when* and *how* she could respond to our request. This contradicts the first interpretation in that Khun Jieab would have been exhibiting the value *Maximizing Study Abroad* describes as collectivistic, in which a person puts the needs of group before the needs of herself. She may not have been considering whether or not she should agree to do the task, but only searching for a means by which to accomplish the task regardless of her busy schedule.

Khun Jieab also may have simply been trying to comprehend our request. English is a second language for her, and she often asks us to repeat our questions, speak slowly, or write down a request. Because this occurrence was at the beginning of our trip, it is likely that she was having more difficulty understanding our accents. Further, we were not yet accustomed

to speaking more slowly. Thus, the puzzled look could have been indicative of Khun Jieab processing our request.

Although my first reaction was to believe that Khun Jieab was trying to think of a way to say no, based on research of Thai culture, I believe that it is much more likely that she was trying to find a way to help us. According to William Klausner, an expert in Thai culture who stayed in Thailand for 30 years, most Thai people tend to place the needs of the group before their own needs. Further, every time we asked her for a favor during our two month stay, she accepted the responsibility and completed the task regardless of her busy schedule. Although I felt awkward because it seemed as though we were inconveniencing her, based on research and events after the fact, I believe that Khun Jieab was willing to help but unsure about how to begin doing so. From a different cultural perspective, I would not have immediately interpreted her reaction as a hesitation to do the task we asked.

I also realized that Thai people seem to often ask each other for favors and complete them for each other. When Khun Jieab asked her friend Khun Koy to help us, it was very inconvenient for her. However, because they are friends, she agreed to the favor. In our situation, Khunying Finola Chatamra asked Khun Jieab to help us. Thus, it seems as though Khun Jieab would be willing to do what we asked if she had a means to do so.

Michael Taglieri's:

A Helping Hand

Every person is asked and asks for favors to be completed every day, it is a natural social interaction. When a person is in a foreign country, especially one that does not speak their language, they often times require even more assistance than normal. While completing my Interactive Qualifying Project in Bangkok, Thailand, my group and I needed to complete many different tasks that could only be obtained through the use of the Thai language. These tasks included setting up and carrying out a patient survey, determining manufacturers, negotiations with manufacturers, and many others. Unfortunately, our group did not have anyone who was fluent in Thai and we had to rely on the assistance of others to complete these tasks. As a result of this we often had to inconvenience people, but to my surprise, every Thai person we asked for assistance willingly agreed to help.

There are two specific instances where the assistance of a Thai person went above and beyond what was expected. In my groups and my attempt to distribute a patient survey at the Queen Sirikit Centre for Breast Cancer, we required a great deal of assistance from somebody who spoke and wrote Thai as well as English. Our group knew an employee in the kitchen, Khun Tik, who spoke both English and Thai and contacted her to see if she could assist us in our efforts. She was more than happy to help even though she was extremely busy and had no obligation to assist us. Further, she continued to assist us with future interactions where a translator was required even though she did not need too. The second example, also dealing with the establishment of our patient survey, dealt with the assistance of two local Thai students. While trying to translate our survey from English to Thai, we found it difficult to translate various terms between the languages and required assistance communicating the ideas correctly. Our group only needed to ask one person and she immediately stopped what she was doing, asked for a friends assistance, and worked on translating the survey for the next thirty minutes. Similarly to the woman in the Centre's kitchen, this student had no obligation to assist us but helped nonetheless.

There are various reasons why this assistance was given to our group and some of the most likely of those are as follows. Not assisting us could possibly lead to an awkward situation and Thai's generally avoid confrontations (Niffenegger, Kulviwat & Engchanil, 2006). Additionally, as Niffenegger et al. states, a Buddhist principle is to place the needs of

others before one's own, and thus, their willingness to help could be a result of their religion as many Thai people are Buddhist. Further, principles such as this are most likely taught and shown to children from a young age so it becomes a fundamental belief and is not seen as a task. Lastly, our group could have been lucky in asking people who were genuinely good people and wanted to help out of the goodness of their heart.

It is my belief that this helpfulness is a result of the difference in culture, in which the religion is a major part of this difference. The Buddhist principle to put other's needs before one's own, along with this trait most likely being a fundamental part of many Thai's upbringing, are in my opinion the main reasons why our group was assisted whenever we needed it. Both of the people in these examples, as well as other observations which I have had, were usually very busy with other items but always seemed to put our needs before theirs. It should be noted that the assistance which we received went above and beyond what would be expected based off of my experience in Western culture and thus, these events occurring as a result of the people being nice and kind is probably not likely to be the main reason, but is most likely a factor in the events occurring.

Witnessing these acts of kindness made me evaluate the Western culture. Because these events are not as common in western culture I wondered, are Westerns selfish? Are we too caught up in our own lives to understand that other people are important too? Although these are questions which I have not determined an answer too nor does one truly exist, they are interesting ones to ask. Further, to adjust to the culture I have tried to adopt traits such as this while in Thailand and it has been an interesting experience. Although it can be a nuisance to go out of one's way to help somebody, it leaves a great feeling with you after you complete a generous act. Additionally, I wonder if Thai people view these favors as inconveniences. Do they really want to help all of the time, or do they just feel obligated? I have tried to understand the motives behind these acts but it is difficult because of the difference in culture and upbringing. However, I am engaged by this difference and similar ones and I am led to believe that Thai people do gain satisfaction from helping others just as I do. Although there are many fundamental differences between the two cultures differences such as these are the most interesting to me because of the complexity of why the differences exists.