INNOVATIVE ANALYSIS

CROWDED REFRIGERATORS

1. BRIEF DESCRIPTION OF THE SITUATION

The refrigerator tends to collect items until it is so full it seems that nothing can be found when you go to looking for it. Items that one uses daily or on a very regular basis tend to get "sorted" to the front of shelves or into prime placement in the doors. Everything else seems to get "shoved to the back." Then, when you start looking for something, you don't find it so go to the store and buy it again only to find out months later that you actually did have that item but it was covered up by something else and now you have two that will remain in the fridge for another year.

Clearly, the refrigerator presents multiple opportunities for increasing the organization and accessibility of items in the fridge. We have models with pull-out shelves and adjustable components but obviously that is not the total answer. The challenge of this exercise is to come up with ways to reduce the clutter in the average refrigerator.

Pull-out shelves already exist but are not the best answer. Often, things fall over, or behind the shelf while sliding it in and out. Also, it does not allow the owner a better view of the contents of the shelf until one pulls it out (so you wind up pulling each one out looking for what you need).

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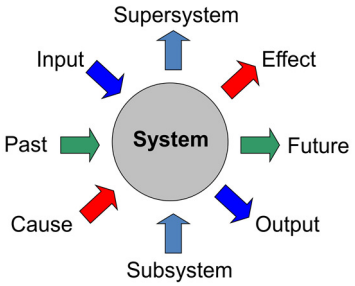
2. DETAILED DESCRIPTION OF THE SITUATION



This section contains the results of doing the "8-Way analysis." At right is the 8-Way diagram showing four pairs representing four different ways to describe your system. The brief description is one abstraction of your system. This section contains four additional abstractions. Later, the PF diagram represents yet another abstraction. Each of the four ways to view the system has its own section number (2.1 – 2.4). You can use text here, but diagrams are also useful since they convey a large amount of information. The purpose of this section is to identify important characteristics, components, features, parts, processes, and entities related to the system your are studying. This, along with the brief description should give you plenty of information with which to draw the PF diagram. In general, everything in your PF diagram should appear somewhere in these descriptions. However, you may choose not to include something you describe here in your PF diagram. Part of the reason for doing this analysis is to help you narrow down your efforts on a part of the system.

2.1 SUPERSYTEM/SUBSYSTEM ANALYSIS

The refrigerator is made up of three parts: the freezer, the fridge, and the cooling unit. The freezer can be broken down into several parts. First, there is the ice maker, which contains the ice, a time releaser of making the ice, the mechanical parts of the icemaker to help change the water into ice cubes, and the blades inside the dispenser to help crush and/or dispense ice. There is, also, several non-removable glass or plastic shelves inside the freezer to place objects on. In some freezers there can be one to two deep basket holders at the bottom of the freezer that can be pulled in and out. Furthermore, there is additional storage space within the door of the freezer to store either small items or items that need to be quickly accessed. There is a temperature turn dial on the inside of the freezer, so that the user of the fridge can control how cold they want their freezer to be. Lastly, there are lights in the top or in the sides of the freezer so the user can see to find the objects they want easier.

Secondly, there is the fridge part of the refrigerator that can be broken down into several different parts. First, there is, again, the removable glass or plastic shelving that objects can be placed upon. There is additional shelving in the door area where the user can place their smaller, but commonly used items. Furthermore, at the bottom of the fridge, there are between two to three pull-out drawers, which are usually see-through, where the user can put in their meats, fruits, and vegetables. In addition, there can be several removable storage spaces for the "particulars", such as eggs and butter, but that is provided by very few fridges today. Secondly, there is a temperature turn dial on the inside of the fridge. This temperature dial can be changed to how cool the user wants the fridge to be and how cool the user wants to set each of their drawers.

Lastly, there are lights in the top and in the side of the fridge so the user will be able to see what items are located inside.

Finally, the last part of the fridge is the compressor unit inside. According to Wikipedia.com, "modern refrigerators usually use a refrigerant called HFC-134a, which does not deplete the ozone layer, like Freon. In Europe, the main refrigerant used now is R-600a, or Isobutene, instead of R-134a. This refrigerant occurs naturally and therefore it has a smaller effect on the atmosphere, if released." In many refrigerators, the freezing air is released into the freezer and then passed over the fridge area to providing the cooling to the fridge, but also in many refrigerators there are separate units that control the cool or cold air in freezer and the fridge areas.

2.2 INPUT/OUTPUT ANALYSIS

Electrical power is used to keep the fridge running.
Pull the door handle to open the fridge door.
Push the door handle to close the fridge door.
Pull the door handle to open the freezer door.
Push the door handle to close the freezer door.
Objects are placed inside the fridge by hand (to store food).
Objects are taken out of the fridge or freezer by hand for reorganizational purposes.
Objects are taken out of the fridge or freezer by hand for cooking or eating needs.
Objects are taken out of the fridge or freezer by hand for cleaning purposes.
Objects are taken out of the fridge or freezer by hand because items inside are spoiled or rotten.
Plug in the fridge to keep the items inside cold or frozen.
The user grabs a shelf and pulls it out.
The user grabs a shelf and pushes it back in.
The user pushes the 'ice' button (or a tab) to receive ice.
The user pushes the 'water' button (or a tab) to receive water.
The user pushes the 'crushed' button to change the ice maker to give out crushed ice.
The user pushes the 'solid' button to change the ice maker to give out solid pieces of ice.
Opening the door to the fridge or freezer turns on the lights.
Closing the door to the fridge or freezer turns off the lights.
The user moves items in fridge to find other items.
The user shakes the ice maker or ice holder to break up ice that might have frozen in place.
The user shakes the ice maker or ice holder to break up big ice pieces that have collected near the dispenser opening.
The user can press the "Filter" button to turn off the light.
When the filter needs to be changed, the fridge shines a light at the "Filter" button, signaling the user that it needs to be changed.

2.3 CAUSE/EFFECT ANALYSIS

Pulling on the door handle will open the door to the freezer or fridge.
Pushing the door handle will close the door to the freezer or fridge.
Opening the door causes the light to come on.
Closing the door turns the light off.
Pressing the crushed ice button and pushing the tab in on the fridge will give you crushed ice.
Pressing the solid button and pushing in the tab on the fridge will give you solid pieces of ice.

Pressing the water button will give you water.
Ice maker will not give the user in ice their glass if there is no ice present.
Old food smell will cause user to clean out fridge.
If fridge is off, ice will melt and will cause a mess.
If the fridge is not plugged in, the food will not stay cold and will spoil.
If the fridge is not plugged in, there is no cold air getting into the fridge.
If fridge is full and you reach to the back, most likely something will be knocked out of the fridge or freezer.
Having a matching fridge with the kitchen will increase the property value of the house.
Having a fridge will keep food cost down.
Having a fridge will keep the user from going to the grocery store daily to get groceries.
If the door is not closed, the power bill with rise.
If the door is left open, the food will spoil.
If the door does not close all the way, the user will fix and move objects in the fridge until it is closed.
If the door does not close, insects and animals will be attracted to the food.
If the user is looking for a particular object, other objects will most likely have to be move to find said object.
When the filter to the fridge needs to be changed, some fridges give off a light telling the user that it needs to be changed.
When the filter has been changed, the user can press the "Filter" button to make the light turn off.

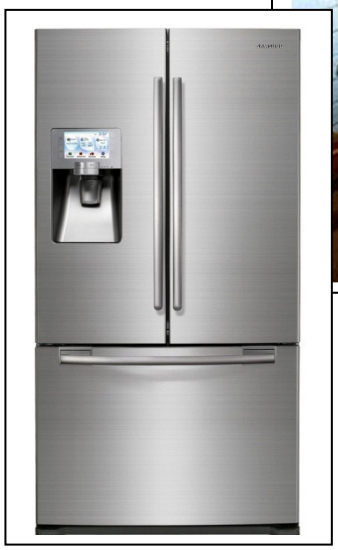
2.4 PAST/FUTURE ANALYSIS

Before there were refrigerators, there were very few ways to keep food fresh or cold. One of the earliest methods for keeping food fresh is food preservation, which is still practiced today. Some types of preservations are salting, smoking, canning, preserves, and pickling. Throughout history, people have used underground cellars to preserve food. People would line these cellars with natural insulation and stored ice and snow inside. These cellars were used to preserve food year around. There were also ice houses. Towns would store the ice and snow from the previous winter inside the town's ice houses. These ice houses protected all types of food, but it stored mainly meats. Then there are ice boxes. Ice boxes were used inside of a person's home instead of outside the home, like the cellars and the ice houses. The ice had to be replaced daily and there was need of constant cleaning of the water off the floor.

The refrigerator was invented by Jacob Perkins in London in 1834. Edward DeBono writes "In his British Patent Specification of 1834, he (Perkins) describes the vapor compression cycle, in which cooling was produced by the evaporation of volatile fluids." The early fridges used ammonia, a highly toxic gas, to create the cooling effect. Since this gas is lethal, some consumers were found dead in front of their fridge. After many deaths, companies removed the toxic ammonia, which lead to the creation of Freon in the 1920's. Freon is now no longer used since being banned in the 1990's due to its harmful effects to the Ozone layer.

Early refrigerators were made out of wood cabinet and a water-cooled compressor unit. These refrigerators cost about $714. A Model-T only cost $450 around the same time. Around the early 1920's, porcelain and steel cabinets replaced the wooden ones. In the 1950's and 1960's, automatic defrosters and automatic ice makers were created and added the refrigerators. It made having and maintaining a fridge a lot easier. Today's refrigerators now have water and ice cube dispensers, which can be received from the door of the almost any fridge in production. With the

wide variety of designs and affordability of owning a refrigerator, over 99% of the U.S. population has a refrigerator in their home, with many homes even having two of them.



3. RESOURCES, CONSTRAINTS, AND LIMITATIONS

3.1 AVAILABLE RESOURCES

1. Steel
2. Phosphorous
3. Tungsten
4. Plastic
5. Glass
6. Silicon
7. Refrigerant
8. Electricity
9. Economically friendly
10. Design and build quality due to economic pressures and standards
11. Temperature sensors
12. Motor
13. Expansion Valve
14. Metal coils
15. Vents

3.2 ALLOWABLE CHANGES TO THE SYSTEM

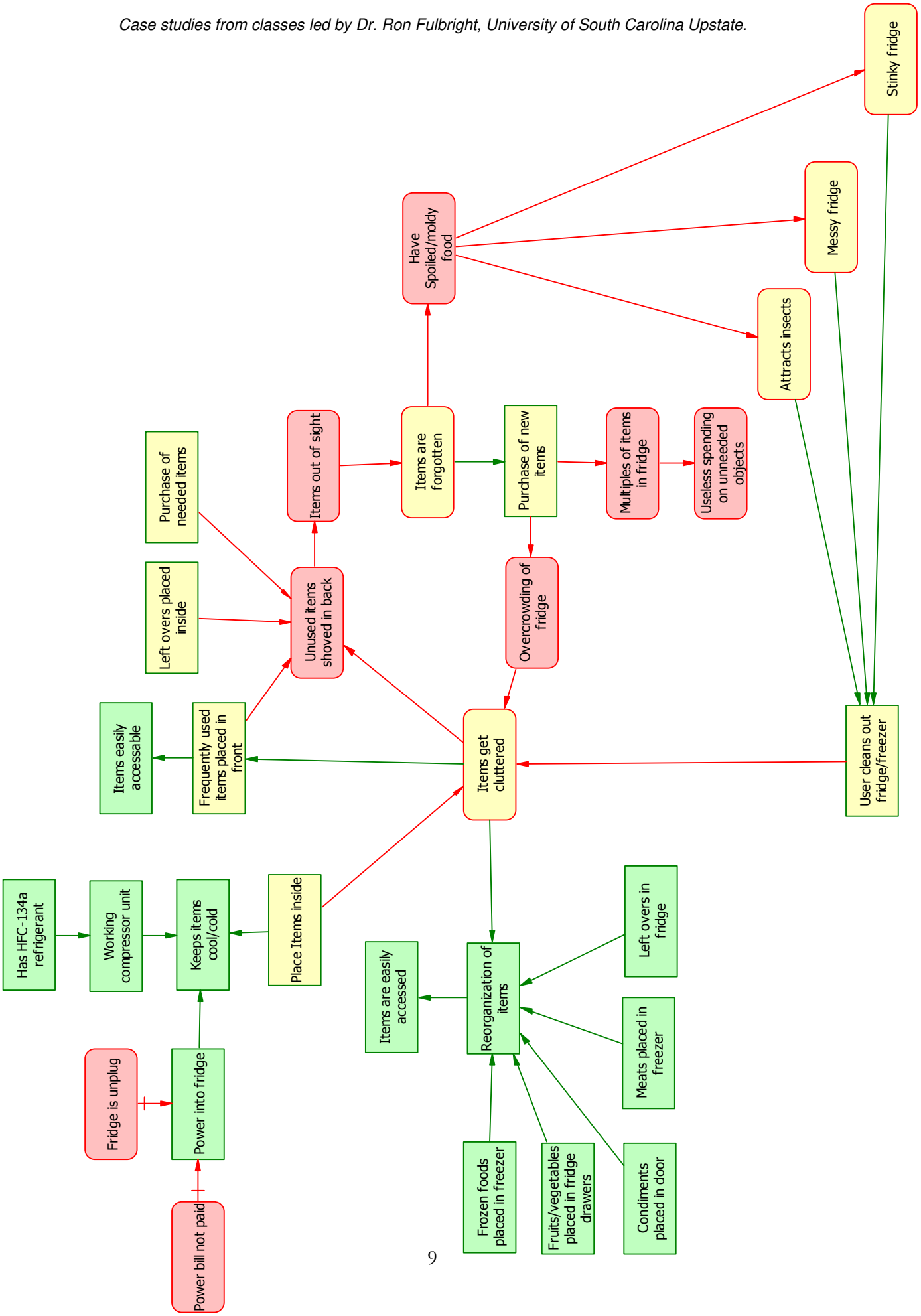
1. Allow better quality materials
2. Enhance overall size
3. Enhance size of drawers and shelving
4. Increase weight capacity of shelving units
5. Ease of use by adding more storing units

6. Ease of use by better organizational methods

3.3 CONSTRAINTS AND LIMITATIONS

1. Power input
2. Power output
3. Cost efficiency
4. Size of kitchen
5. Size of fridge
6. Time cycle of cooling in freezer
7. Size of items in fridge
8. How much money you have available
9. Number of items that can be placed into the fridge
10. The amount of cooking
11. Placement of items depending of shelving space
12. Size of the drawers and shelving
13. Weight capacity of shelving is limited
14. Temperature sensors are used when temperature is above its set point

4. PROBLEM FORMULATION

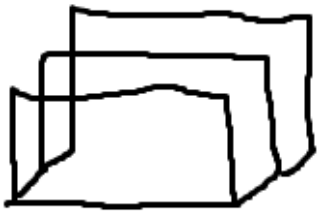

Stinky fridge
Messy fridge
Attracts insects
Have Spoiled/moldy food
Items out of sight
Items are forgotten
Purchase of new items
Multiples of items in fridge
Useless spending on unneeded objects
Purchase of needed items
Left overs placed inside
Unused items shoved in back
Overcrowding of fridge
Items easily accessable
Frequently used items placed in front
Items get cluttered
User cleans out fridge/freezer
Has HFC-134a refrigerant
Working compressor unit
Keeps items cool/cold
Place Items inside
Items are easily accessed
Reorganization of items
Left overs in fridge
Meats placed in freezer
Condiments placed in door
Fruits/vegetables placed in fridge drawers
Frozen foods placed in freezer
Fridge is unplug
Power into fridge
Power bill not paid

5. IDEAS

1) Transform objects shape
   a) Make the fridge wider so that the space that is available is not very deep in width so that way the user could not shove things too far in the back
2) Use curvilinear form – reduce overall dimensions and use another dimension
   a) Make the inside fridge a rotating circle…just like the cooled vending machine with rotating slots.
   b) Have several different shelves that are not to deep but are able to hold things such as buckets of food or a heavy objects like a watermelon
   c) Allow the user to turn the inside of the fridge.
   d) If it is spun to fast, there is a mechanism inside that will automatically stop the rotation for an amount of time or by the closing and reopening of the door.
3) Transform object shape
   a) Have a walk-in fridge so that way the user can see everything and will have a lot of space to store everything.
4) Use a mediator and use a model or copy
   a) Make program that is embedded into the fridge that keeps track of what you have and can show what you have by having a screen on the outside of the fridge or detached from the fridge(so it won't freeze)
5) Nesting
   a) Have a fridge and then have smaller additional fridges inside by sectioning it off and use clear doors to see what is inside and each door will have writing on them designating that section for particular objects (vegetables, meats, etc.)
6) Use the reverse side operator
   a) Make the fridge where you can open the door two ways instead of one.
   b) Both doors can have storage space
   c) Since the width of the fridge is not that deep things cannot be easily forgotten if both the front and the back of the fridge can be accessed
   d) The compressor can be located on either the left or right or both of the other sides of the fridge.
7) Separate on conditions and partition
   a) Have the fridge located underground. When you want something out of it, just press and button and it comes out of the floor and there you have access to anything you need. When you are done with it, just press the button again and it will go back down into the floor.
      i) We can apply multiple smaller fridges used for certain circumstances with this idea. Make a fridge just for drinks or alcoholic drink or both and have the fridge either be located in the wall or in the floor. The user can press a button and the fridge comes out. The user can get what they need and then press the button again to send the fridge back into the wall or floor.
8) Shelter inside another substance

a) Have a can dispenser in the door of the fridge so that cans will not have to take up space on the inner shelves.

9) Segment (modularize)
   a) Have a pull out drawer that is designated for lunch meat. Have the segments metal, but the middle area there is nothing there. Make it square in shape. Segmented each part vertically and connected at the very bottom so that when you set a pack of lunch meat down in it, each one is separated making it easier to access each thing of meat.



10) Add a strengthening element (#25 in the res)
   a) Make fridge airtight so that food will not go bad as quick and bugs will not get inside the fridge.
      i) Make the sealer around the fridge door stronger so that it is more air tight.
11) Partition into simple-shaped parts, make an object dismountable, and partition then integrate. (#18 in the res)
   a) The creation of a condiment dispenser such that when a button is pushed the user can receive things like ketchup, BBQ sauce, and salad dressings.

12) Separate opposite requirements based on condition-Identify a parameter or condition that can change so that the system can meet one requirement under one condition and the opposite requirement under another condition. (#24)
   a) Make two or more different types of shelving options, such as circular and rectangular shelves, so that certain items have a designated spot in the fridge.
13) Facilitate detection in advance-If a harmful effect has occurred and it is necessary to conduct a search or investigation (for lost or damaged objects, for individuals responsible for the harm, etc.) consider making arrangements beforehand that will facilitate the search. (#37)
   a) Create a program or response mechanism that will tell the user of when an object is out-of-date or close to being out-of-date.
   b) Have a scanning system embedded in the fridge so that when the user places in an item, can be scanned and item is known.
      i) The user then will tell the system the expiration date of the said object.
   c) Would be able to tell at a later date because the user would have placed in the item name and the date into the system as they placed or scanned the object that is going inside.
14) Make an object dismountable (#39)
   a) Make a specific area for left-over's that is the width of the fridge and is dismountable and easily accessible.

15) Use curvilinear form – reduce overall dimensions and use another dimension (utilize space resources) and make an object dismountable
    a) Make the whole fridge circular so that everything inside will spin on one bar.
    b) Have several different shelves that are not too deep but are able to hold things such as buckets of food or a heavy objects like a watermelon
    c) Allow the user to turn the inside of the fridge or have an automatic spinning mechanism
        i) Auto spinning mechanism stops when door is opened
    d) If it is hand spun to fast, there is a mechanism inside that will automatically stop the rotation for an amount of time or by the closing and reopening of the door.
    e) Shelving will have to be shaped to the fridge…so if it is circular the shelving needs to be curved to fit the circular rotation.
    f) Allow for sections to be removable for easier viewing and help with organization.

16) Partition
    a) Make a few smaller multiple fridges. Just take out key items that are most often searched for at particular instances.
        i) Ex. Person is looking for snacks and they also want a drink. Have drink in the same area as the snack. Have a cabinet under the snacks that is refrigerated.
        ii) When cooking, have commonly used items near the stove.
        iii) Keep everything else such as fruits and vegetables, cold condiments, left-overs, pre-cooked meals, already cooked meals for later, and the freezer as the main part of the fridge.
        iv) Have the fridges see through.
17) Partition
    a) Have multiple fridges throughout the kitchen.
        i) Have the freezer located in the bottom of all of the cabinets.
        ii) When cooking, have commonly used items near the stove.
        iii) Keep drinks near snack foods.
        iv) Have grilling condiments near the snack foods.
        v) Keep salad condiments near vegetables/fruits
            (1) Have the salad condiment in the same section as the vegetables/fruits
                (a) Fruits and vegetables are on the shelves and the condiments are in the door.
18) Change on conditions
    a) Make the fridge or fridges go from opaque to translucent.
        i) When the user comes within a certain range of the fridge (say 1-2 ft), the fridge or the fridge door changes from opaque to translucent to allow the user to see inside.
            (1) When the user is out of range, the fridge remains opaque.
        ii) Place button or switching mechanism near the fridge so that when the user want to see inside, they can just press the button and it transform from opaque to translucent.
19) Partitioning followed by integrate (integrated by the tubes attached to main fridge and the other smaller fridges) and link degeneration during partitioning (Partial separation of partitioned object parts, with rigid or dynamic links preserved between them.)

a) When you make the fridge separated in multiple parts, don't let each part be its on refrigeration unit. Have cords connecting these fridges to a main freezer where it will receive its cooling from.

20) Link degeneration during partitioning
   a) Allow the fridge shelves to move up and down vertically. (Think of a chicken cooker in a grocery store and how it automatically rotates)
      i) There a chain that can be pulled to allow of movement of the shelves
         (1) Better yet the shelves moves automatically and can stop when the user opens the door to the fridge or presses a button to rotate the fridge to a designated area.
      ii) The shelves need to be linked in a way such that when it rotates all the food does not go everywhere; so possibly use same technology as a Ferris wheel.
         (1) Add a metal holder for the shelf so that it is reinforced just in case the shelf break
         (2) The metal holder will have a small section in the back that will allow the chain to go through it and move the shelves.
         (3) Or the metal holder will have a small section in the back that will be holding a rod that will rotate as the chain is rotating around.
            (a) Instead of the whole bar rotating, add a rotator cuff to the end of the bar and allow the metal shelves to go around that way.
      iii) Rotation will be slow to moderate speed so that the user can see what he/she has.