UNIVERSITI TEKNOLOGI MALAYSIA

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SECD 2613 System Analysis and Design

Section 08

PHASE 3:
SYSTEM ANALYSIS AND DESIGN

Low Carbon Initiatives Community Monitoring System
<CarbonCutOffPro>

To_Be_Continued(Team 7)

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TABLE OF CONTENTS

1. INTRODUCTION

Phase 1 of the project discussed the Iskandar Puteri Low Carbon (IPRK) initiative, aiming to promote low carbon living in the Iskandar Puteri community. However, there are few challenges faced by the MBIP department when they are organizing the IPRK related programs such as inefficient manual processes, scattered data sources and limited resident engagement. The initiative mobilizes various stakeholders through programs such as LA21 and Drive Thru Recycling ro reduce carbon emissions and energy consumption. Due to the constraints posed by manual processes and decentralized data, this project aims to develop an enhanced platform to transform the original system into an automated system through modern technologies such as mobile apps.

Moving on to Phase 2, the focus shifts to analyzing the current MBIP carbon monitoring system. We had gathered information through interviewing and STROBE to obtain enough information to conduct in-depth analysis of the AS-IS system. Our efforts in creating context diagrams and data flow diagrams aims to create a strong fundamental analysis for proposing effective solutions in the next phase.

Phase 3 will mainly focus on proposing effective solutions to address the identified challenges within the old MBIP carbon monitoring system. This phase 3 report aims to provide a detailed roadmap for the development and implementation of the TO-BE system to achieve the goal of promoting low carbon living. The primary scope of this report is developing the Physical Data Flow Diagram for TO-BE system, constructing the structure chart to show the modules involved and writing a detailed process specification for each of the child diagrams. It also aims to provide a comprehensive understanding on how the system is going to be implemented for the users. Hence, this phase 3 report will present the roadmap for the implementation of an enhanced MBIP carbon monitoring system.

2. PROBLEM DEFINITION

a. Inadequate monitoring of project implementation status

The Iskandar Puteri Low Carbon (IPRK) initiative currently lacks an effective system to monitor the implementation status of its various projects and activities on reducing carbon emission within the area. However, there is no centralized platform to track the progress of initiatives by the MBIP planning department in a systematic way. MBIP does not have visibility on whether planned environmental projects have actually been executed, are on track or delayed. Without tracking of project timelines, IPRK cannot gauge implementation rates and identify the potential bottlenecks to be addressed.

b. No centralized platform for carbon data

IPRK has limitations to store project data and outcomes in a centralized or easily accessible system. Currently, data on emissions reductions or other metrics from implemented initiatives is siloed and scattered. For instance, the data collected are all stored in separate Excel files for further analysis. There is no unified platform to gather the data from multiple sources and projects to display the outcomes. This will highly restrict the ability to demonstrate tangible processes and results to stakeholders as well as the public.

c. Limited analytics on project progress over time

While IPRK undertakes different projects aimed at reducing carbon emission, the initiative still lacks a robust system to analyze project outcomes over time. This is because the project timeline will not update in a centralized system. The project progress will only be updated based on the report and documentation from the project manager. Therefore, quantifying results from the initiatives are required to identify trends. However, the current system is unable to generate such insights by analyzing data annually. Failure to analyze the data annually will be hard in revealing progress rates and planning future strategy.

d. Labor-Intensive Carbon Emissions Computations

The IPRK initiative currently involves manual computations to derive carbon emissions reductions from various projects. Calculation of carbon emissions metrics based on the water bill and electrical bill relies on manual aggregation of data points on water and waste. This will involve manual calculation based on a large quantity of data collected. They need to perform extensive mathematical calculations by using the formula in order to quantify carbon impacts. This hands-on computations process is time-consuming, inefficient and prone to human errors that might influence the data accuracy.

e. Limited User Awareness in Sustainability Efforts

While IPRK aims to promote low carbon practices across communities, there appears to be limited awareness and engagement among end users. For instance, the residents's unfamiliarity with using tools like Google Forms to participate in data collection. This indicates that many of them lack understanding of how to track their own carbon footprints in their household. Some of them might make some mistakes when filling up some important information in the Google Form due to there being no restriction in limiting the answer from the residents. Without proper knowledge, it seems to be hard for them, especially the senior citizens, to contribute effectively to regional decarbonization goals.

3. INFORMATION GATHERING PROCESS

3.1 METHOD 1 : Interview (Using pyramid)

Description:

We will conduct a comprehensive assessment of the project and carbon reduction efforts by combining surveys and in-depth interviews. The survey will collect feedback from stakeholders, while the interviews will provide deeper insights. The results of both methods will be combined to provide a complete picture of the project's progress and effectiveness.

Implementation:

To gather in-depth feedback and insights, we conducted semi-structured interviews with key stakeholders involved in the IPRK program. The stakeholder that we choose is MBIP Planning Department Staff who is responsible for designing and implementing carbon reduction policies and measures.

Interview Process:

Duration: 15-20 minutes.

Format: Combination of open-ended and closed-ended questions.

Close-Ended Questions

Question 1 : How would you rate the current effectiveness of the existing system in monitoring project implementation status on a scale of 1 to 5, with 1 being highly ineffective and 5 being highly effective?

Answer :

I think the scale might be 2. (less effective)

Question 2 : Do you currently have a centralized platform to track the progress of environmental projects within the IPRK initiative?

Answer :

No. I handle the progress manually by receiving the report from the consultant

Question 3 : On a scale of 1 to 5, how would you rate the accessibility and organization of the current system for storing project data and outcomes, with 1 being very disorganized and 5 being very organized?

Answer :

I will give it 2 out of 5 which is quite disorganized as we use separate excel files to store the data obtained from the competition.

Open-Ended Questions:

Question 4 : What is your broad vision on how a sustainability platform can accelerate carbon reduction efforts within Iskandar Puteri?

Answer :

We aim to create a city-wide sustainability platform that brings together data from various sources, offering a unified view of efforts to reduce carbon emissions across the Iskandar Puteri area.

Question 5 : What are some practical difficulties faced by your department in quantifying the environmental impact of current initiatives?

Answer :

We currently face some difficulties in centralizing dispersed Excel-based emissions data, as well as manually computing complex footprint formulas which consumes resources. Moreover, it takes us a lot of time to categorize and analyze the carbon consumption data before preparing a full report for each of the competitions.

Question 6 : What kind of visibility do you expect on project status tracking that would significantly improve oversight?

Answer :

We want to stay on top of project progress in real-time. In this case, we want to track whether each of the programs that we run in different areas are under our expectations or it might be delayed due to different uncertainties. Therefore, we hope to get immediate alerts if there are unexpected delays, so we can act quickly to keep things on track.

Question 7 : Is replacing formula-based carbon calculations with a rules engine a key expectation?

Answer :

Yes, we expect the new system can help us to eliminate the process of calculating the carbon consumption manually. Therefore, we need the new system to provide us with a standardized algorithm that can help us to compute the data efficiently and minimize the errors.

3.2 METHOD 2 : STROBE(Structured Observation of the Environment)

Description:

The evaluation of carbon reduction projects within the Iskandar Puteri Low Carbon (IPRK) initiative will be conducted using an unobstructive method, which is the STROBE (Structured Observation of the Environment). This method is used to observe the decision-maker's physical environment. Usually, it is possible to observe the particulars of the surroundings that will confirm or negate the organizational narrative. By applying the STROBE, there are five symbols used to evaluate the observation of the elements compared with interview results which are checkmarks, 'X', oval or eye-shaped symbol, square and circle.

Implementation:

To implement the STROBE method, we had performed an in-depth observation in the competitions that have been organized in Iskandar Puteri Rendah Karbon for about three weeks. Here are the activities that we conducted during the observation:

1. Observing resident behavior:
    - How do the residents take part in the carbon reducing competition such as can they find the booth easily and can they complete the task effortlessly?
    - Analyze to identify high carbon consumption activities to target.

2. Evaluating competition participation:
    - Station trained observers at registration booths during registration.
    - How the helpers at booths assist the senior citizens in completing the form.

3. Reviewing community events:
    - Track attendance and engagement of Iskandar Puteri community for the competitions.
    - Track the time taken to key in the data into the system including analyzing the data.

Result gained from STROBE:

- Most of the residents, especially the senior citizens, need assistance from the helpers to complete the Google Form.
- Residents will take a long time to fill up the Google Form as they are unfamiliar with the Google Form.
- Calculation on carbon consumption using the formula is time-consuming and easy to get errors.
- Data entry process is slow because there will be a huge amount of data to be processed before it can key in into the system.

3.3 SUMMARY

Through the interview session, we have gained a deep understanding of the problems and challenges that the MBIP planning department faced when running the IPRK programs. We had prepared a bunch of questions which include open-ended and closed-ended questions which can help us to identify the requirements of the department. We are using the pyramid structure method when interviewing our stakeholders. The reason behind this is it will break down the questions into several parts. We will begin by asking detailed questions followed by open-ended questions and more generalized responses. This will be useful to help the stakeholders to be warmed up to the topic or seem reluctant to address the topic.

The Structured Observation of Environment (STROBE) technique was used to evaluate Iskandar Puteri's low carbon competition initiatives. Residents participating in the competitions were observed over 2 weeks across areas such as ease of accessing registration booths, completing competition forms, computing carbon footprints and tracking participation. Some key observations obtained from STROBE are that senior citizens struggled with the Google forms used in competitions, manual data entry and calculations were time consuming, error-prone carbon computations using complex formulas and delays due to large data processing. By using STROBE, it identifies challenges that the residents faced with using the Google Form and current process gaps resulting in delays.

4. REQUIREMENTS ANALYSIS (AS-IS SYSTEM)

This section will describe current business processes such as the scenarios and workflow of the system. Then, we will determine the functional requirement and non-functional requirements of the current system to construct the data flow diagram later. There are several items need to be included in functional and non-functional requirement such as input, process and output.

4.1 CURRENT BUSINESS PROCESS

This section will discuss the scenarios and workflow of the current business process:

a. Iskandar Puteri Residents

1. Registration of users based on categories such as participants.
2. Select type of users.
3. Fill in personal details such as full name, phone number, address and others.
4. Select type of data to be inserted. (Electricity, Water, Waste, Recycle Cooking Oil)
5. Follow the guideline to follow the data by months.
6. Fill all required information and click submit.
7. Repeat steps 4-6 for other categories.
8. Do a survey of lifestyle for carbon footprint.
9. Declaration form and submit the form.

b. MBIP Consultant

1. Registration of users based on categories such as participants.
2. Select type of users.
3. Fill in the details.
4. Validate the submission of participants for final competition.

c. MBIP Planning Department

1. Prepare question banks to be asked.
2. Construct a Google Form with the questions.
3. Distribute Google Form to participants through competition.
4. Collect data from participants.
5. Compile data and save into different Excel files.

6. Analyze the data.
7. Generate reports based on the data.

4.2 FUNCTIONAL REQUIREMENT

4.2.1 Context Diagram

Process	Input	Output
IPRK System	Question bank Carbon consumption data Resident detail Energy consumption data Raw data	Spreadsheet report Participation report Competition data Google Form Competition guideline Registration data

4.2.2 Level 0 Diagram

Process	Input	Output
Submit Data	Energy consumption detail Resident detail	Competition data Resident data
Prepare Google Form	Question Bank	Google Form Question
Validate Data	Raw data	Resident detail Competition detail Participation report Raw competition data
Analyze Data	Carbon consumption data	Categorized data
Generate report	Categorized data	Spreadsheet report

4.2.3 Level 1 Diagram

4.2.3.1 Process 1 : Submit Data

Process	Input	Output
Select type of user	Menu choice	User type
Fill in personal detail	Resident data User type	Resident
Select data type	User type	Data type
Fill in energy consumption data	Data type Energy consumption detail	Form completion
Click complete and auto-submit	Form completion	Competition data

4.2.3.2 Process 2 : Prepare Google Form

Process	Input	Output
Select the questions	Question bank	Selected question
Design the form	Selected question	Completed form
Check and test form	Completed form	Extra questions Complete Google Form
Modify the form	Extra questions	Google Form questions
Publish form	Complete Google Form	Google Form questions

4.2.3.3 Process 3 : Validate Community Data

Process	Input	Output
Receive data	Raw community data	Raw community data
Check data quality	Raw community data	Master
Standardize data	Master data	Resident detail Compiled data Competition detail Raw competition data
Report findings	Compiled data	Participation report

4.2.3.4 Process 4 : Analyze Carbon Consumption Data

Process	Input	Output
Receive data	Carbon consumption data	Carbon consumption data
Analyze carbon footprint	Carbon consumption data	Categorized data Carbon data pattern
Organize data	Categorized data Carbon data pattern	Categorized data

4.2.3.5 Process 5 : Generate Competition Report

Process	Input	Output
Receive data	Categorized data	Categorized
Analyze trends	Categorized data	Visualized data Flagged anomalies
Create a full report	Visualized data Flagged anomalies	Spreadsheet report Program report

4.3 NON-FUNCTIONAL REQUIREMENT

4.3.1 Performance and Control

- Response time - The system should have an average response time of less than 3 seconds for data entry and analysis operations.
- Scalability - The system can handle an increasing amount of data and user activity without significant degradation in performance.
- Hardware utilization - Use larger memory storage and faster processor to prevent bottlenecks and ensure optimal performance.

4.3.2 Security

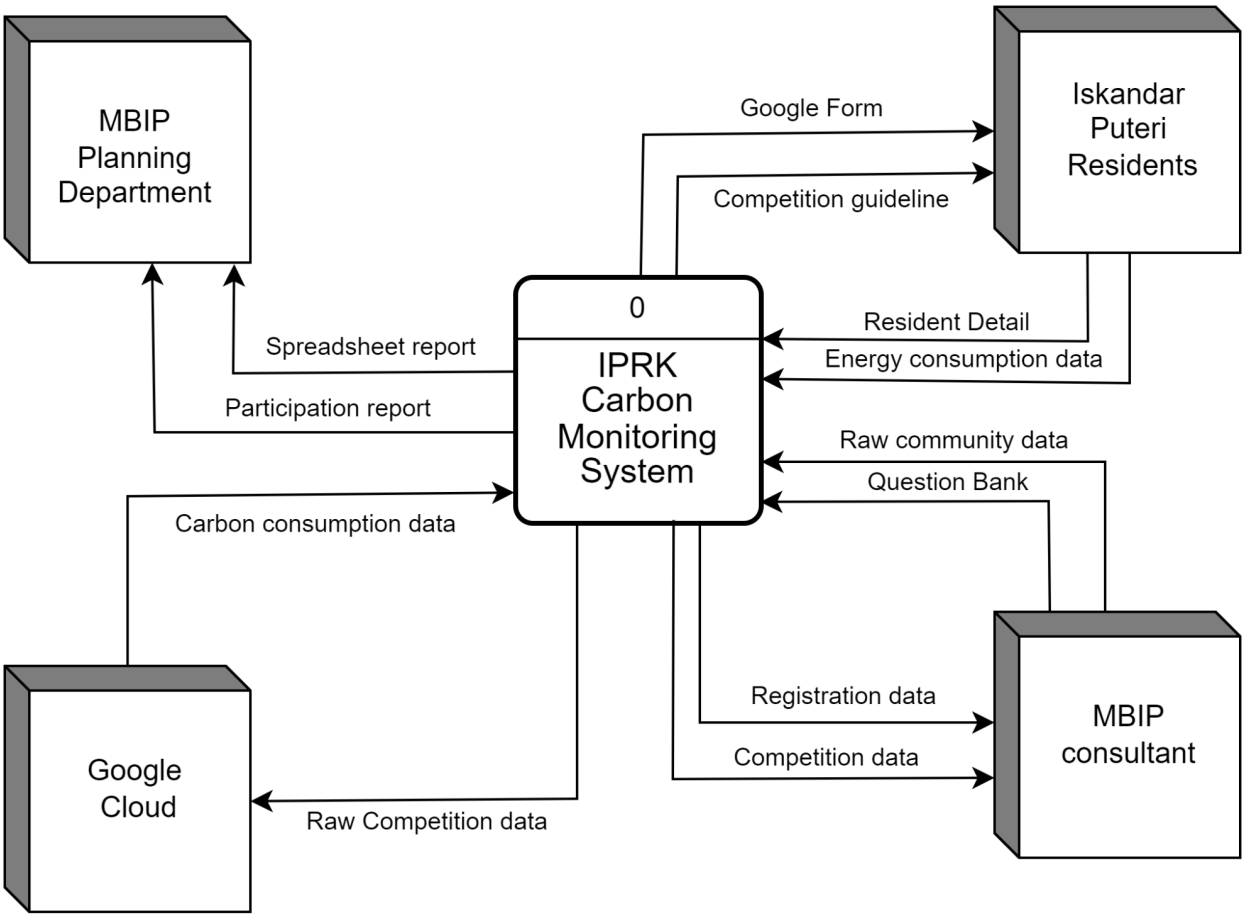
- Data encryption - All sensitive data including resident personal details and carbon footprint calculations should be encrypted to prevent unauthorized access.
- User authentication - A multi-factor authentication should be implemented to verify the identity of users.
- Access Controls - Role-based access controls should be implemented to restrict data access and system functionalities based on various users' roles.

4.3.3 Safety

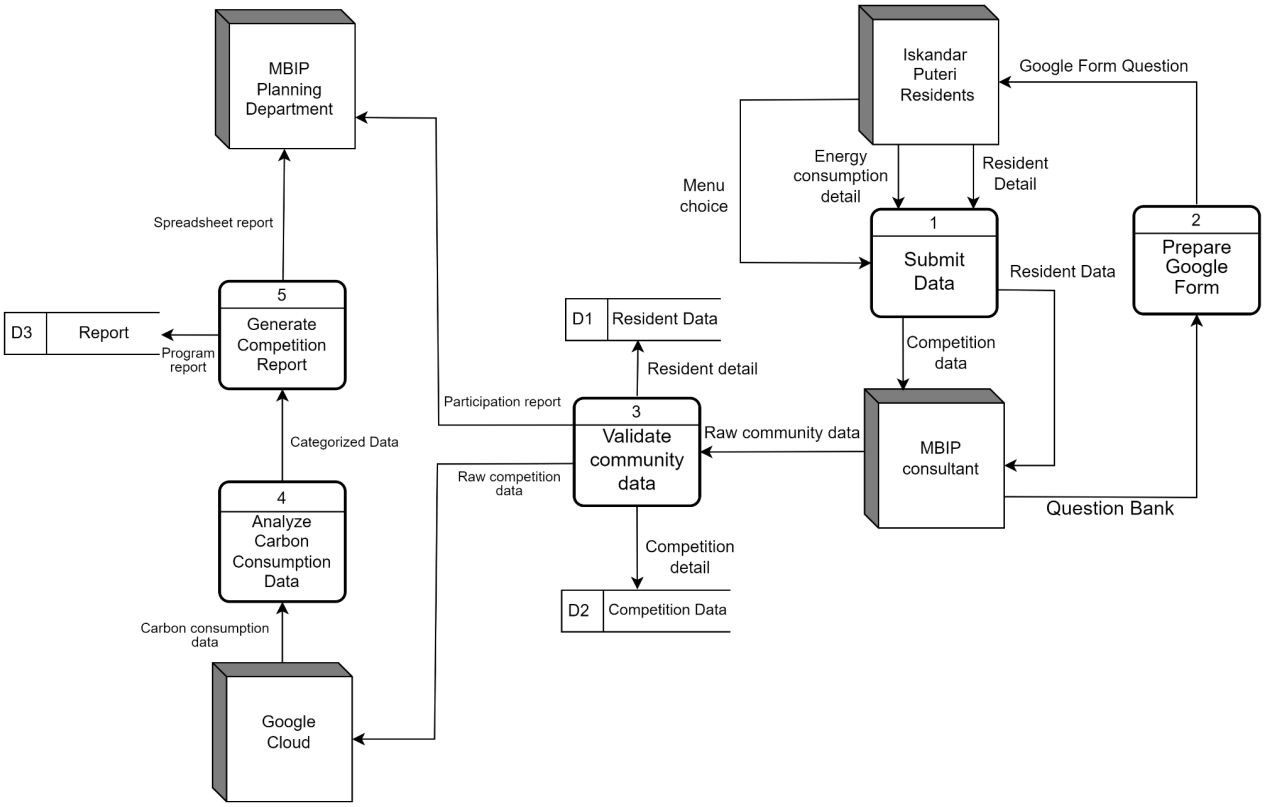
- Data backup and recovery - Regular automated backup of the system to prevent data loss due to system failure.
- Error handling - Verify that user-provided data is in the proper format by implementing input validation checks to stop users from providing harmful or incorrect data.

4.4 LOGICAL DFD AS-IS SYSTEM

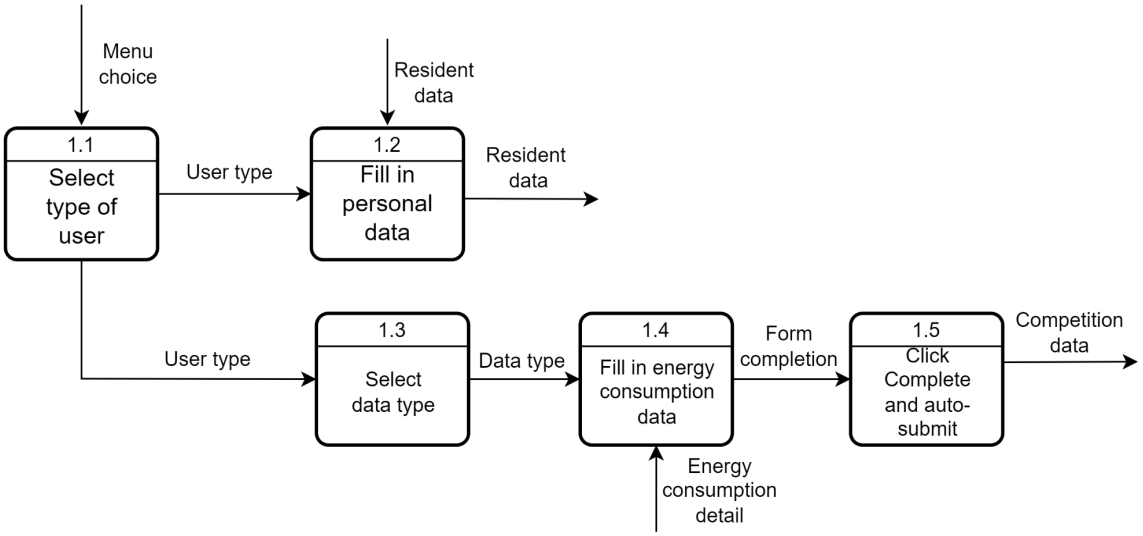
4.4.1 CONTEXT DIAGRAM



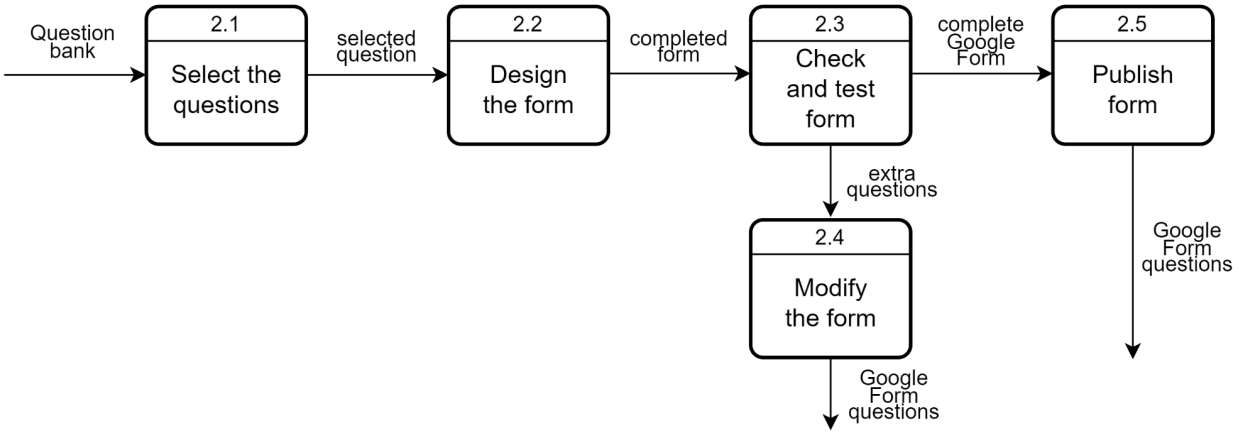
4.4.2 PARENT DIAGRAM DFD LEVEL-0



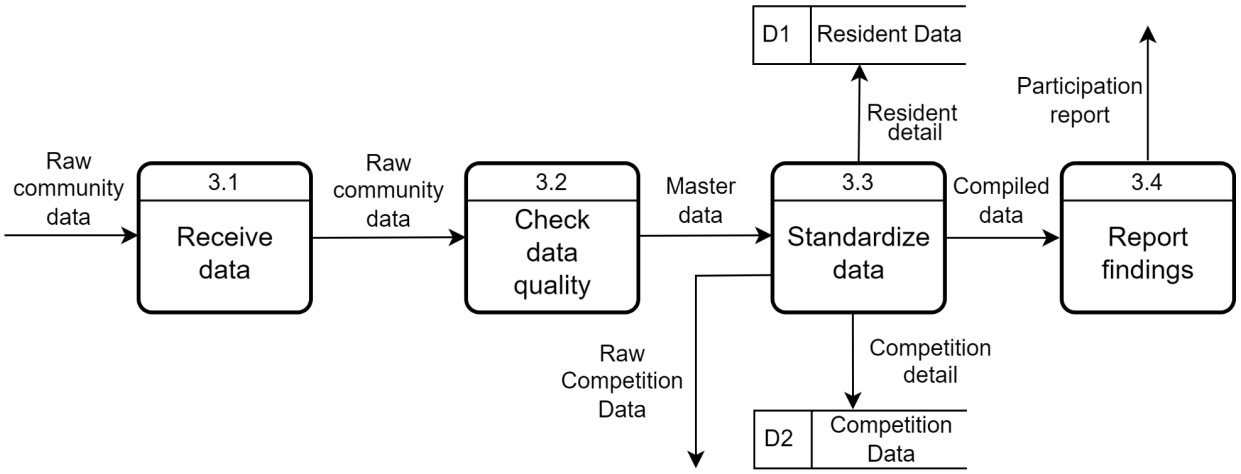
4.4.3 CHILD DIAGRAM DFD LEVEL-1 FOR PROCESS 1 : Submit Data



4.4.4 CHILD DIAGRAM DFD LEVEL-1 FOR PROCESS 2 : Prepare Google Form

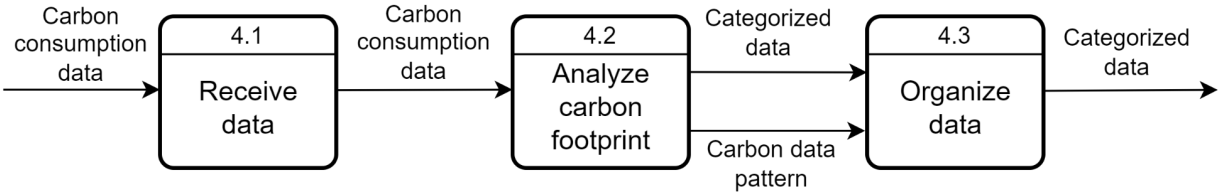


4.4.5 CHILD DIAGRAM DFD LEVEL-1 FOR PROCESS 3 : Validate Community Data



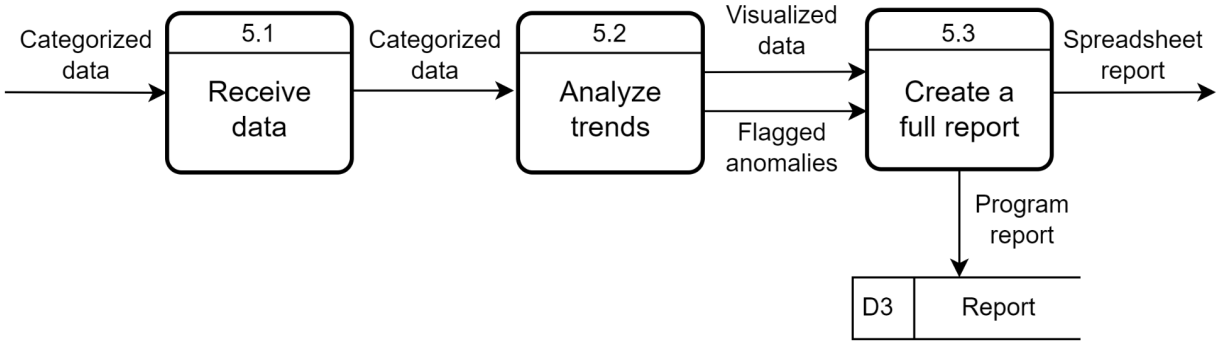
4.4.6 CHILD DIAGRAM DFD LEVEL-1 FOR PROCESS 4 :

Analyze Carbon Consumption Data



4.4.7 CHILD DIAGRAM DFD LEVEL-1 FOR PROCESS 5 :

Generate Competition Report



4.5 SUMMARY

In conclusion, there are few problems that exist in the current system that should be improved or modified. By analyzing the current AS-IS process using two methods which are interview and STROBE, we know that the main problem of the current system is that most of the process will be handled manually. Starting from preparing the questions, they should create the Google Form questions one-by-one and distribute them to the community by organizing some competitions. Moreover, the residents should fill in their carbon consumption manually using the Google Form. The process is time-consuming and easy to send error data as there is no limitation in filling the form. After submitting the form, the MBIP side should analyze and calculate the carbon consumption manually using the formula. This process surely will cause quite a number of problems when calculating the value using the formula. Therefore, the data obtained might be inaccurate. To illustrate more, they should analyze manually to detect which aspects should be concerned more and generate a complete report for the MBIP planning department. All these processes should be handled manually which might cause lack of manpower in completing all the tasks within the time scheduled.

Therefore, phase 2 of our project had to list out the problems and list out the weakness of the current system. We analyzed the current system and developed a data flow diagram to give us a clear understanding regarding the system. We listed out the functional requirements which help us to determine the processes involved, input and output of the process. Next, we developed a context diagram which will show the overview of the current carbon monitoring system. Then, we developed the Level 0 diagram and Level 1 diagram which give us a detailed overview of the sub processes involved in the system. By constructing the diagrams, we can analyze the system better and have a complete solution for the improved version.

To sum up, the current system is inefficient in collecting the community data as well as analyzing the carbon consumption data. Therefore, we should focus on the problems mentioned above and provide solutions toward those problems.

5. SYSTEM ANALYSIS & DESIGN (TO-BE SYSTEM)

5.1 PHYSICAL DFD TO-BE SYSTEM

5.1.1 CONTEXT DIAGRAM

In the context diagram, we can clearly see that there are four main entities created which are MBIP planning department, Iskandar Puteri Residents, MBIP consultant and Google Cloud. We have specified the data flow that is involved in the system to provide a clear image on how the whole system is working.

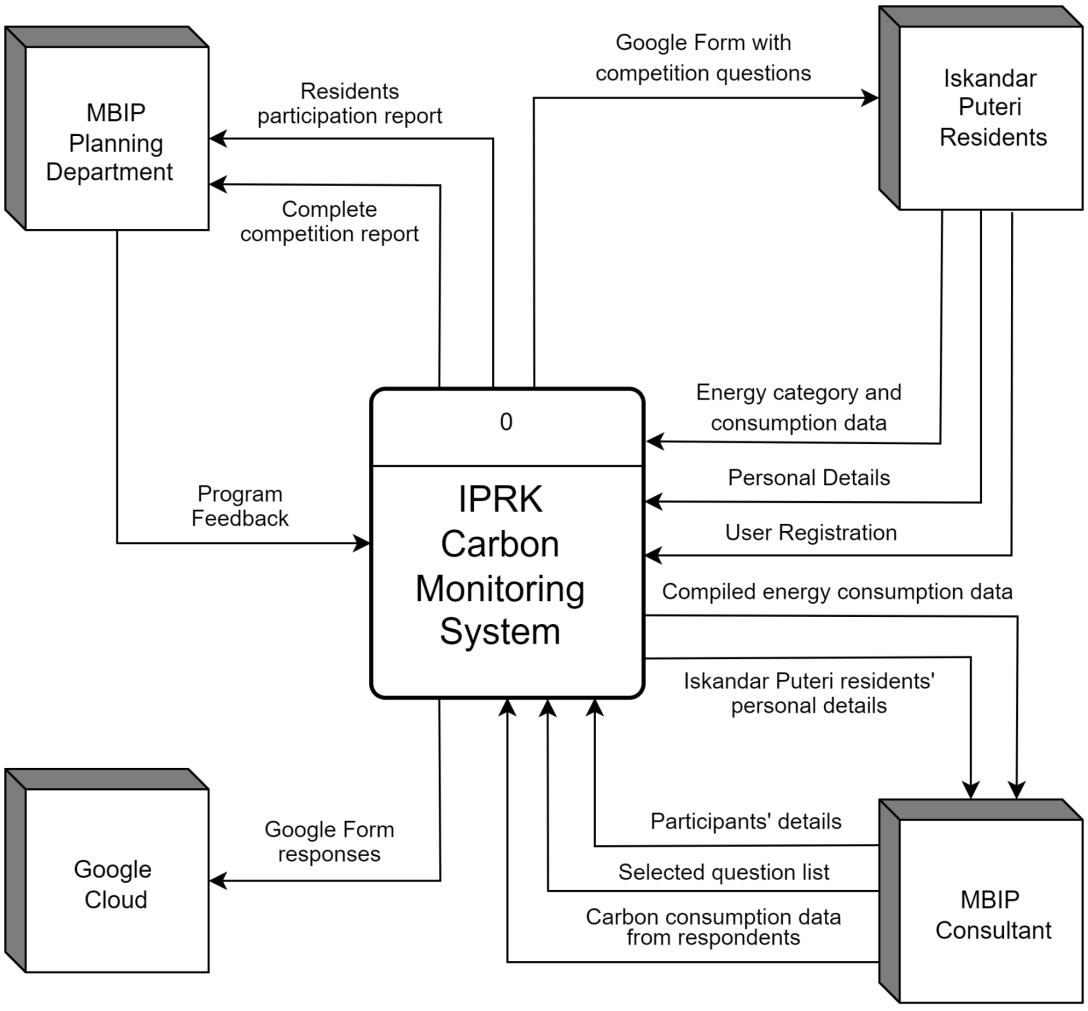


Figure 5.1.1 Context Diagram

5.1.2 PARENT DIAGRAM DFD LEVEL-0

For the parent diagram, we had created 6 main processes which are categorized into automated and manual processes. The automated process is submitting competition data, generating competition reports, generating participation reports, analyzing carbon consumption data and managing community data. On the other hand, the manual process is preparing Google Form which is done by the MBIP consultant. Next, we also create temporary data stores for storing the data during the data flows. The temporary data stores created are Temporary Google Form File, and Temporary Competition File. On the other hand, the name of the data stores has been specified to show the actual data that will be stored in that particular data store.

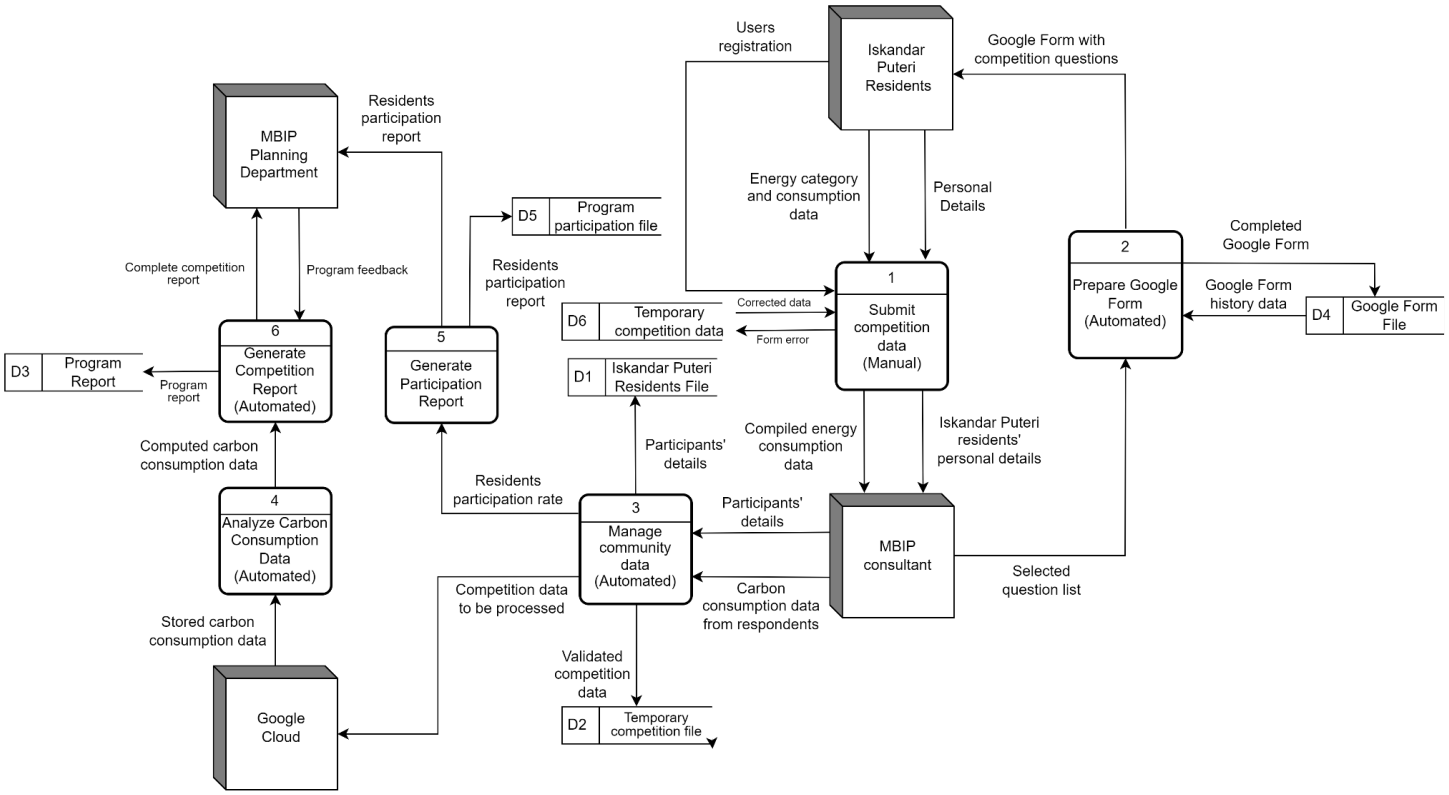


Figure 5.1.2 Parent Diagram DFD Level 0

5.1.2.1 PARTITION DFD

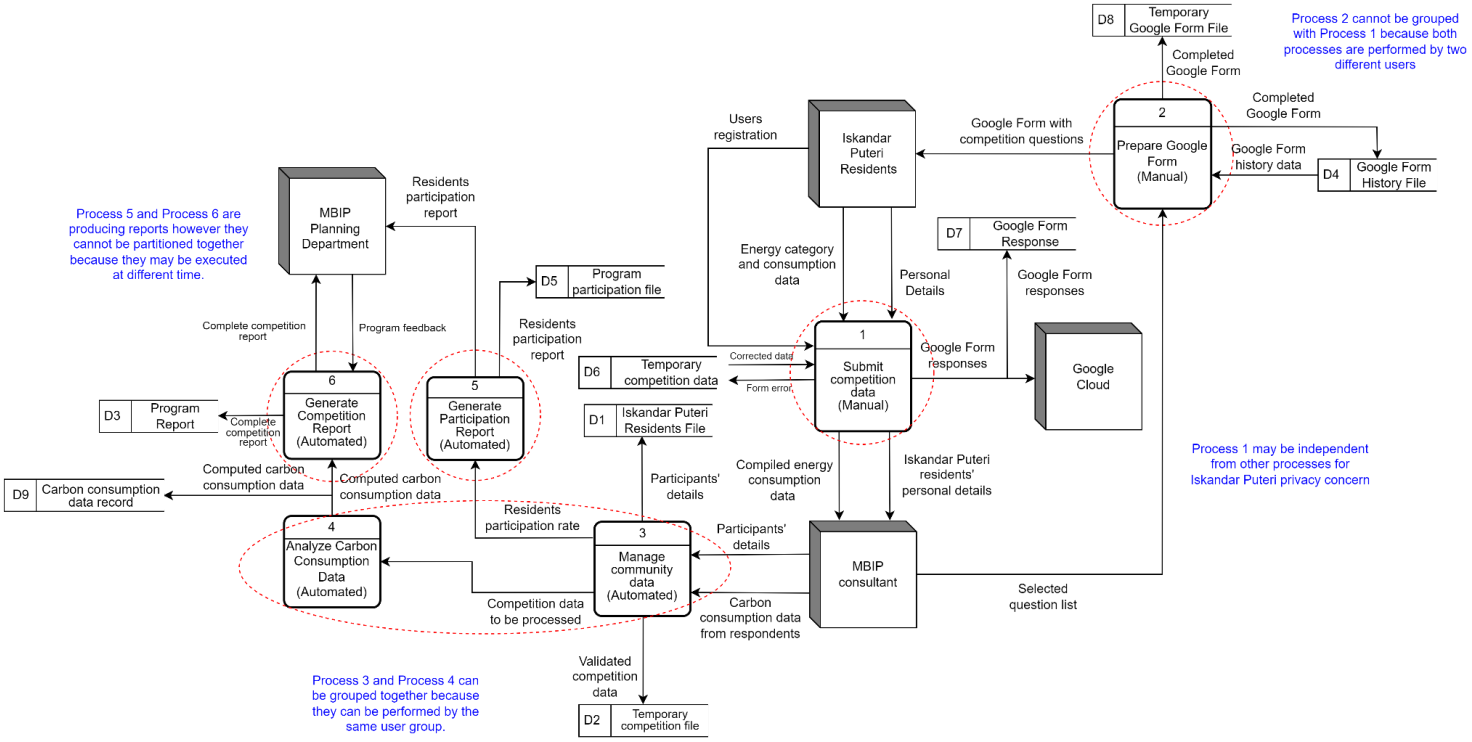


Figure 5.1.2.1 Partition DFD for Parent Diagram with Justification

5.1.2.2 STRUCTURE CHART

For this section, we created a structure chart based on the parent diagram and the child diagrams for Process 1 to Process 6. Each of the processes is converted into their respective modules, which are Module 1 to Module 6. The Carbon Cut Off Pro System acts as a highest-level control module (Module 0) that directs lower-level modules of Module 1 to Module 6. All of the modules will have their own data couple that shows parameters that one module passes to another, and some of them have some control couples that show a flag which one module sends to another. All of these couples are retrieved from the data flows of the parent diagram. Besides, each of these modules 1 to 6 also act as control modules, having their own subordinate modules which will be visualized using the structure chart.

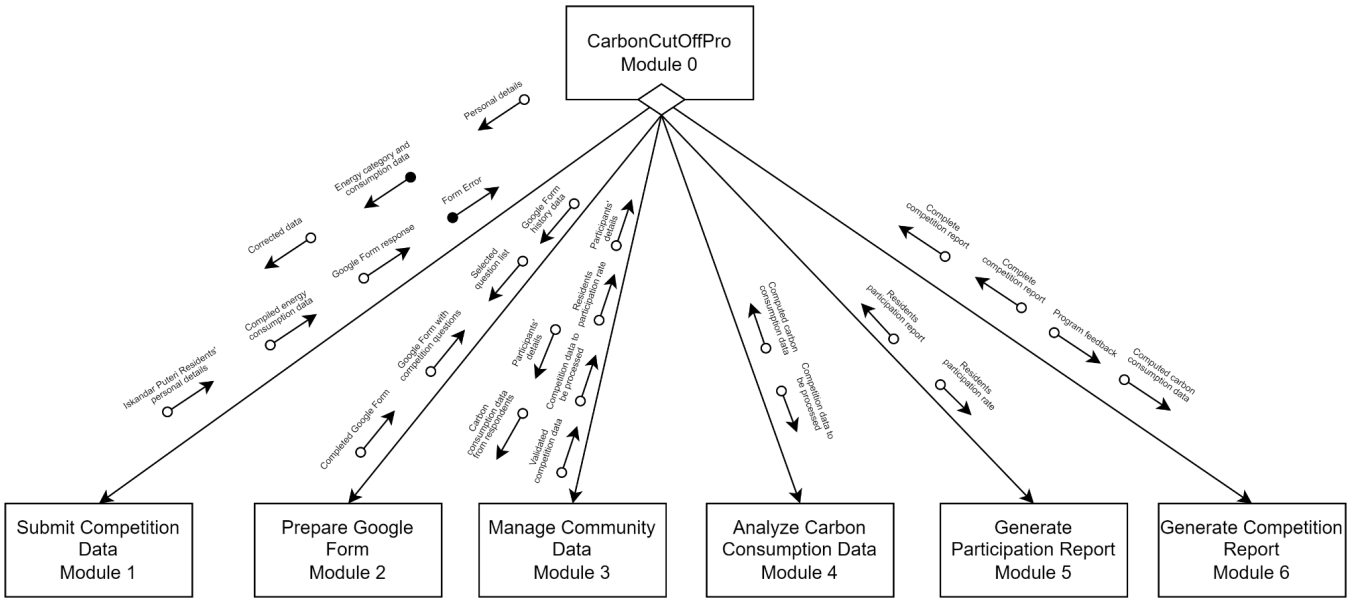


Figure 5.1.2.2 Structure Chart for Carbon Cut Off Pro System

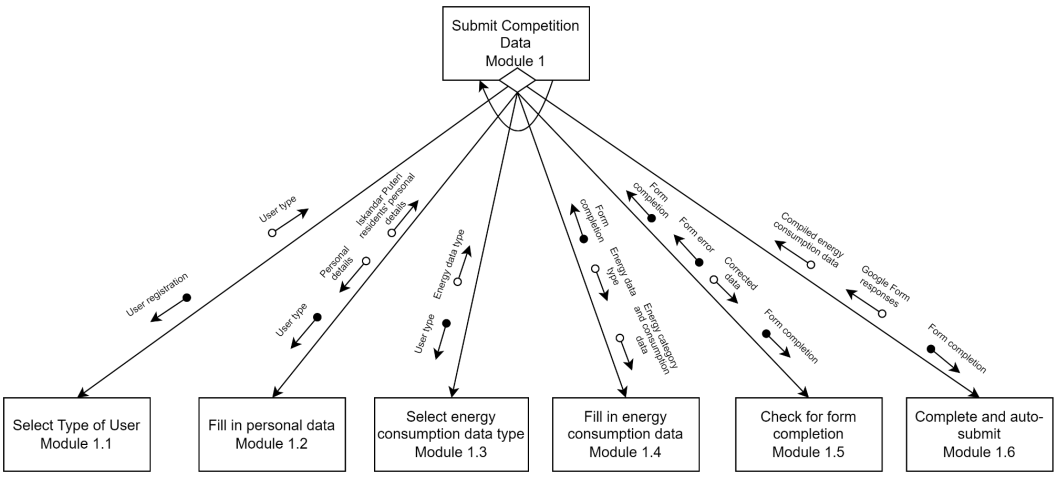


Figure 5.1.2.3 Structure Chart for Module 1 (Submit Competition Data)

Based on the Figure 5.1.2.3, we can notice that module 1 has a total of 6 subordinate modules. There are a few flags that are used to signal the specific condition to other modules. For instance, the User Registration flag is used to signal that the user is successfully registered and ready to proceed with the next step. The User Type flag is used to signal the identity of the user that uses the system. Lastly, the Form Completion flag is used to signal the completeness of the Google Form submission.

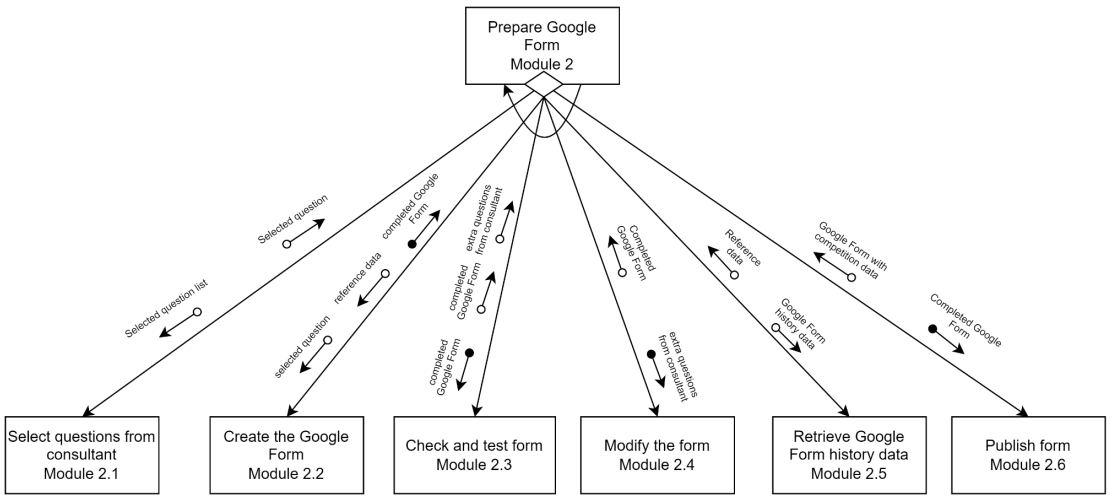


Figure 5.1.2.4 Structure Chart for Module 2 (Prepare Google Form)

Based on Figure 5.1.2.4, we can know that module 2 is controlled by a loop and a specific condition. This is due to preparation of Google Form may need different steps such as checking and modifying until it can be successfully published. Therefore, a loop is needed in this situation. Moreover, the condition will ensure that the Google Form can be published only if the Google Form is fully completed.

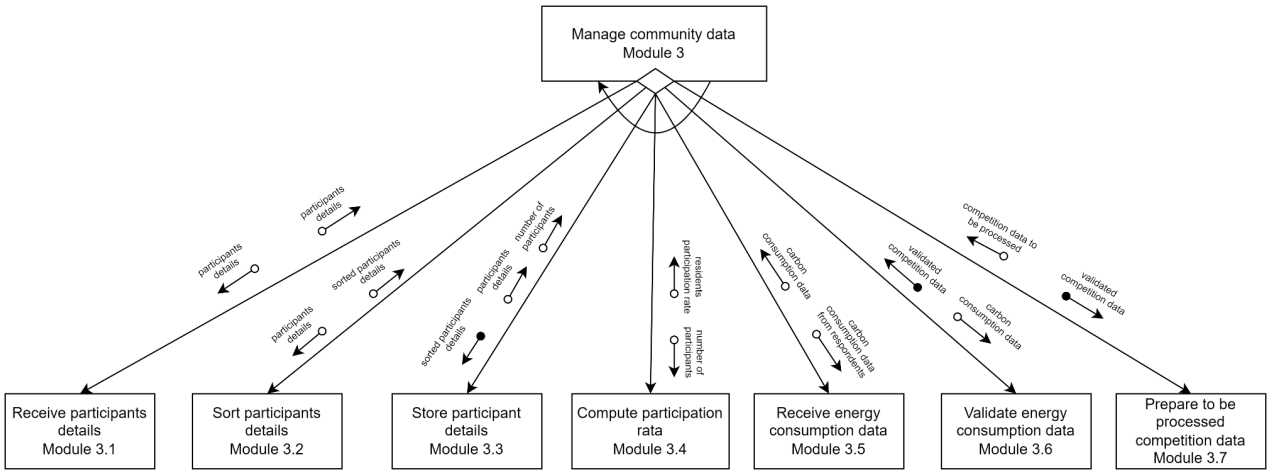


Figure 5.1.2.5 Structure Chart for Module 3 (Manage Community Data)

Based on Figure 5.1.2.5, there is a while loop that is used to check the validation of the carbon consumption data. If the data haven't been validated, the process will repeat again until all the data is validated successfully. Then, the validated competition data flag is used to signal that the data has been validated before preparing the to be processed competition data. There is also a sorted participants details flag that used to signal the data has been sorted according to the expected order.

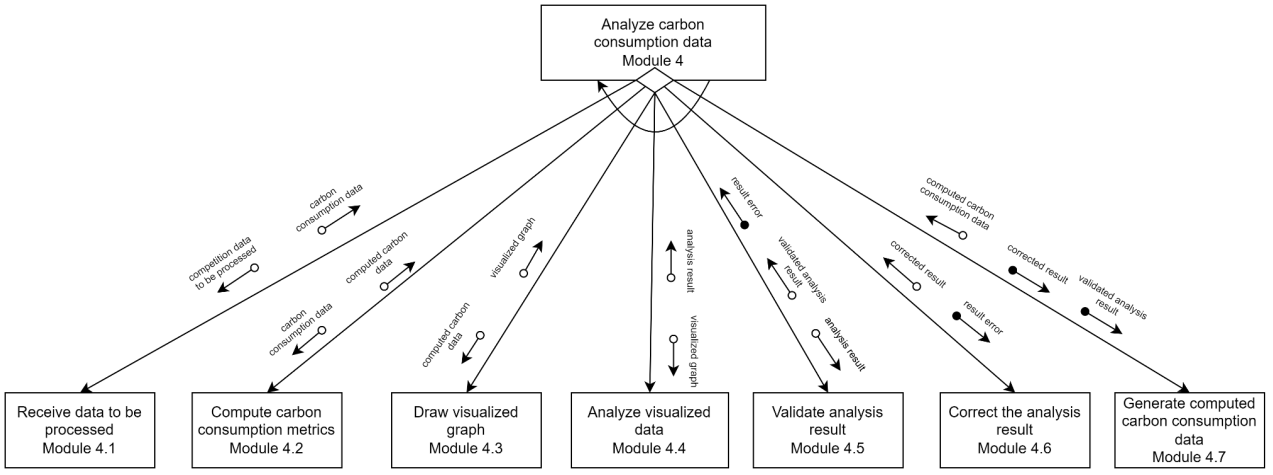


Figure 5.1.2.6 Structure Chart for Module 4 (Analyze Carbon Consumption Data)

Based on Figure 5.1.2.6, there is a while loop to validate the analysis result. The validation process will be repeated again and again until the result is completely validated. Next, the result error flag will signal there are some errors occurred during the validation process. If the condition occurred, then the process of correcting the analysis result will take place and the corrected result flag will signal that the errors have been solved.

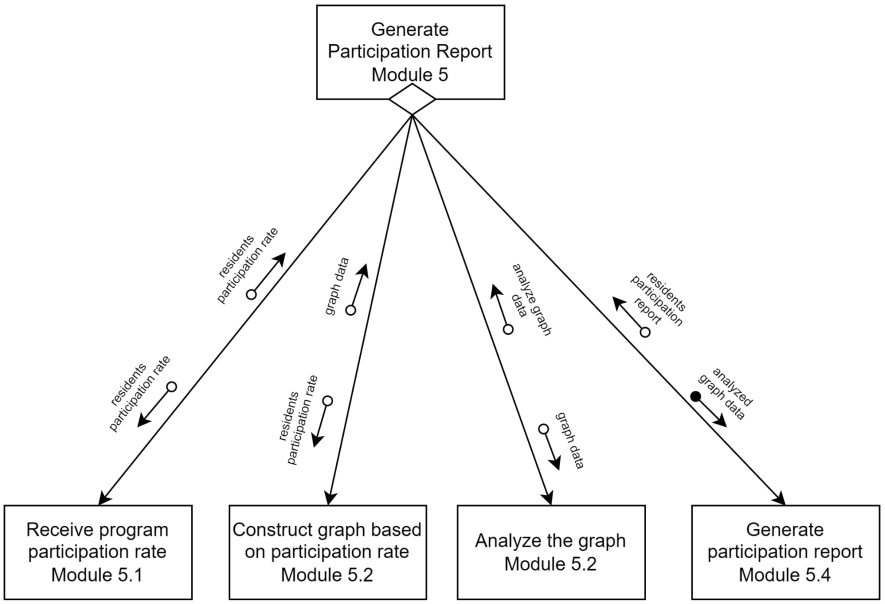


Figure 5.1.2.7 Structure Chart for Module 5 (Generate Participation Report)

Based on Figure 5.1.2.7, module 5 has 4 subordinate modules. There is only one flag which is analyzed graph data which is used to signal that the participation report can only be generated when it receives the analyzed data.

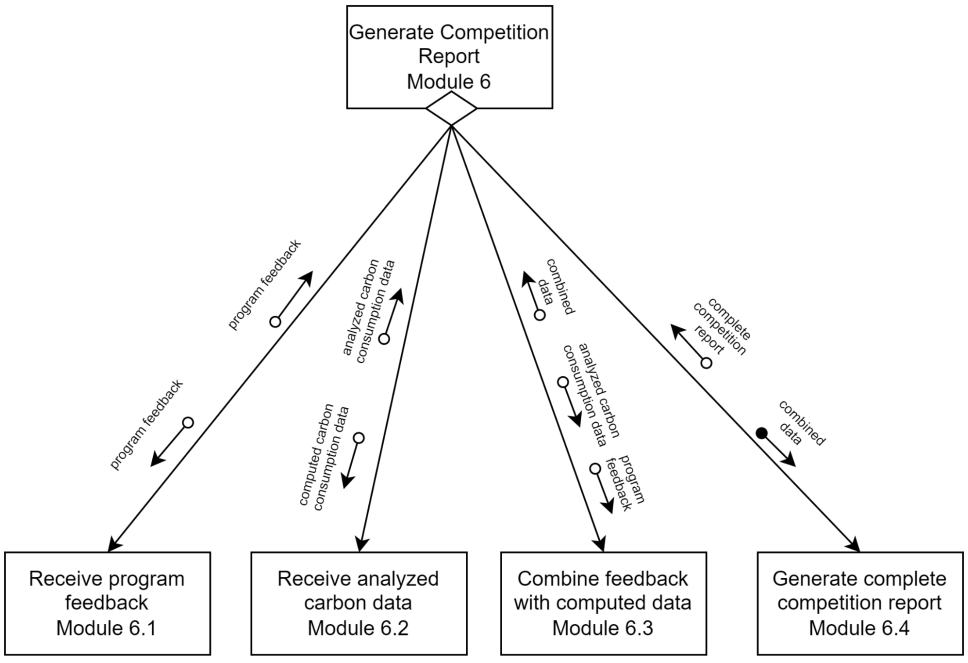


Figure 5.1.2.8 Structure Chart for Module 6 (Generate Competition Report)

Based on Figure 5.1.2.8, module 5 has 4 subordinate modules. There is only one flag which is combined data which is used to signal that the competition report can only be generated when it receives the combined data which are the program feedback and computed carbon consumption data.

5.1.3 CHILD DIAGRAM DFD LEVEL-1 FOR PROCESS 1 : Submit competition data

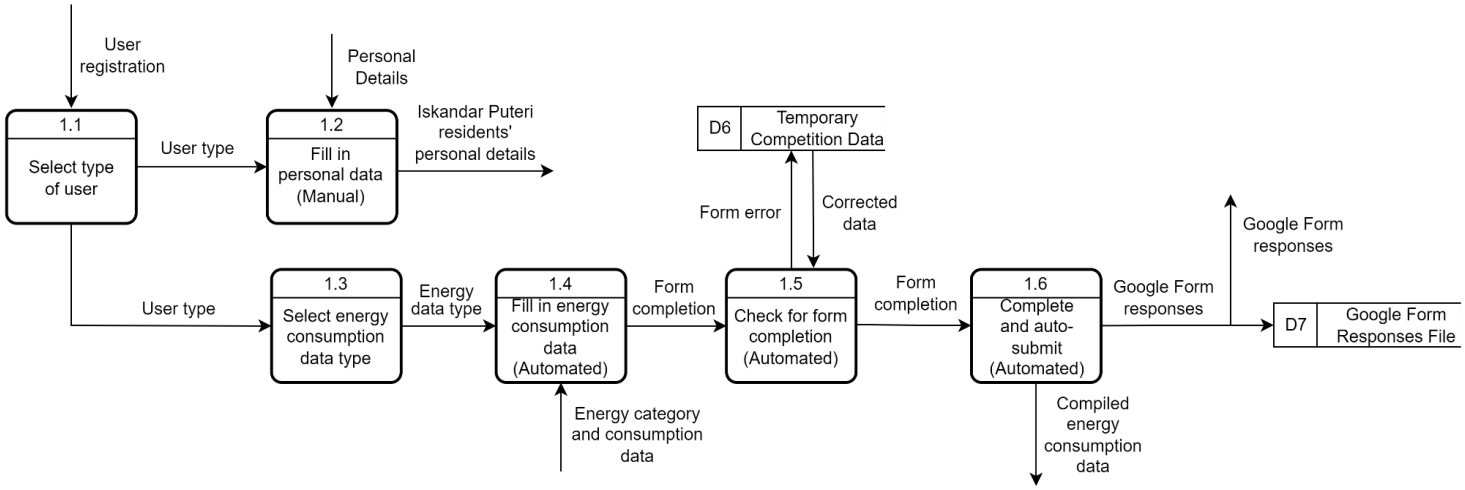


Figure 5.1.3 Child Diagram for Process 1 (Submit Competition Data)

Figure 5.1.3 shows the sub processes involved in submitting competition data. First of all, the Iskandar Puteri residents are required to choose the user type which is the participant. Then, they will need to do two different tasks subsequently. They need to fill in their personal data such as name, address, phone number and other related information. Then, they have to choose the energy consumption data type such as water and electricity. After choosing the type, they need to fill in the details of that particular energy type. Then, the form will automatically check whether they have filled in all the details with the correct format or not. Once the form is completed, they will need to continue filling in for other energy types until every single type is completely filled in. Then, they can click “complete” and the form will be submitted automatically. The temporary competition data (D6) and Google Form response file (D7) are created to smoothen the process.

5.1.3.1 PROCESS SPECIFICATION FOR PROCESS 1 : Submit competition data

Number	1
Name	Submit Competition Data
Description	A way that enables the Iskandar Puteri to fill in their personal details and energy consumption data simultaneously within a system to organize their competition data effectively
Input Data Flow	1. Energy category and consumption data from Iskandar Puteri residents 2. Personal details from Iskandar Puteri residents 3. User registration from Iskandar Puteri residents 4. Corrected data from Data Store 6
Output Data Flow	1. Compiled energy consumption data to MBIP consultant 2. Iskandar Puteri residents' personal details to MBIP consultant 3. Google Form responses to Google Cloud and Data Store 7 4. Form error to Data Store 6
Type of Process	[ ] Online [ ] Batch [✔] Manual

Process Logic	DO WHILE User Type is Participant
	IF User Type is Participant
	THEN Prompt user to Fill In Personal Data
	THEN Select energy consumption data type
	THEN Fill In Energy Consumption Data
	WHILE form is not complete
	THEN ask user to fill in another energy data type
	END WHILE
	ELSE
	EXIT to Main Menu
	ENDIF
	IF form is complete
	THEN Submit the form automatically
	ELSE Repeat the process from WHILE
	ENDIF
	ENDDO

Refer to Name	[✔] Structured English [ ] Decision Table [ ] Decision Tree
Unresolved Issue	1. How is sensitive information protected during submission? 2. Is there any confirmation before the user submits the form?

Table 1 : Process Specification for Process 1 : Submit Competition Data

Structured English:

```
DO WHILE the User Type is Participant
        IF User Type is Participant
          THEN Prompt user to Fill In Personal Data
            THEN Select energy consumption data type
              THEN Fill In Energy Consumption Data
              WHILE form is not complete
                THEN ask user to fill in another energy data type
              END WHILE
        ELSE
          EXIT to Main Menu
        ENDIF
        IF form is complete
          THEN Submit the form automatically
        ELSE Repeat the process from WHILE
        ENDIF
   ENDDO
```

Figure 5.1.3.1 Structured English for Process 1 (Submit Competition Data)

For Process 1 (Submit Competition Data), we choose structured English as the technique of the process specification. This is because structured English is useful in this condition as we need to describe the process which involves repetition and simple structured decision.

5.1.4 CHILD DIAGRAM DFD LEVEL-1 FOR PROCESS 2 : Prepare Google Form

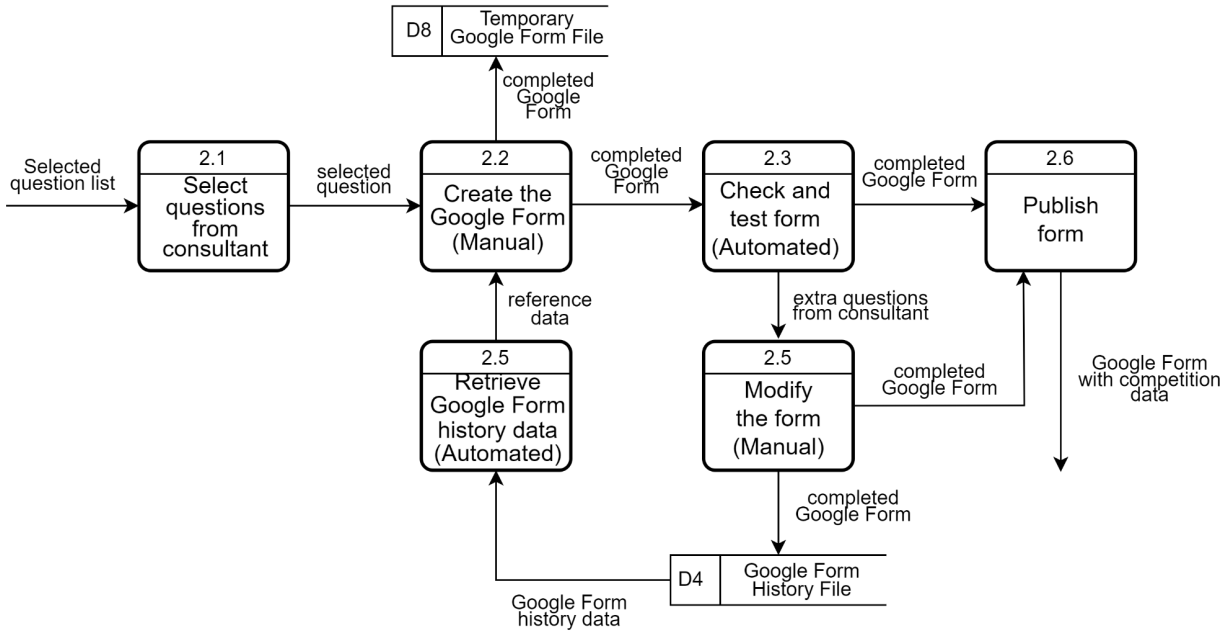


Figure 5.1.4 Child Diagram for Process 2

Figure 5.1.4 shows the sub processes involved in preparing Google Form. Firstly, the MBIP consultant selects relevant questions from the provided list. These selected questions are then used to create a Google Form. Next, the form undergoes an automated check and testing process. If the consultant has additional questions or requires modifications, the form is manually adjusted. Once completed, it is stored in the Google Form History(D4), and the Google Form History data is automatically retrieved. After this, the Create Google Form process is employed, utilizing the Temporary Google Form File (D8) to ensure data integrity and efficiency. If the consultant has no further questions or adjustments, the process proceeds to Public Form, resulting in the generation of competition data.

5.1.4.1 PROCESS SPECIFICATION FOR PROCESS 2 : Prepare Google Form

Number	2
Name	Prepare Google Form
Description	A process allowing MBIP consultant to efficiently create Google Forms by selecting relevant questions from a list, ensuring the forms are specially designed to capture the necessary data for the TO-BE system.
Input Data Flow	1. Google Form history data from Data Store 4 2. Selected question list from MBIP consultant
Output Data Flow	1. Completed Google Form to Data Store 4
Type of Process	[ ] Online [ ] Batch [✔] Manual

Process Logic	DO
	Select questions from consultant
	Create the Google Form and retrieve the reference data from history
	IF first draft of Google Form is complete
	THEN check and test form
	WHILE the form is not approved
	Modify the form
	END WHILE
	ELSE repeat the DO process
	END IF
	Publish the complete Google Form
	ENDDO

Refer to Name	[✔] Structured English [ ] Decision Table [ ] Decision Tree
Unresolved Issue	1.Is data security ensured during the submission of sensitive information? 2.Is a user confirmation mechanism implemented before form submission?

Table 2 : Process Specification for Process 2 : Prepare Google Form

Structured English :

```
DO
    Select questions from consultant
    Create the Google Form and retrieve the reference data from
history
    IF first draft of Google Form is complete
      THEN check and test form
      WHILE the form is not approved
        Modify the form
      END WHILE
    ELSE repeat the DO process
    END IF
    Publish the complete Google Form
    ENDDO
```

Figure 5.1.4.1 Structured English for Process 2 (Prepare Google Form)

For process 2 (Prepare Google Form) , the consultant needs to select a question, create a Google form, perform checks, and may need to make modifications to the form. Structured English can provide a clear, step-by-step description of this process to prevent confusion and ensure a consistent understanding of the task flow among all sub processes involved.

5.1.5. CHILD DIAGRAM DFD LEVEL-1 FOR PROCESS 3 : Manage Community Data

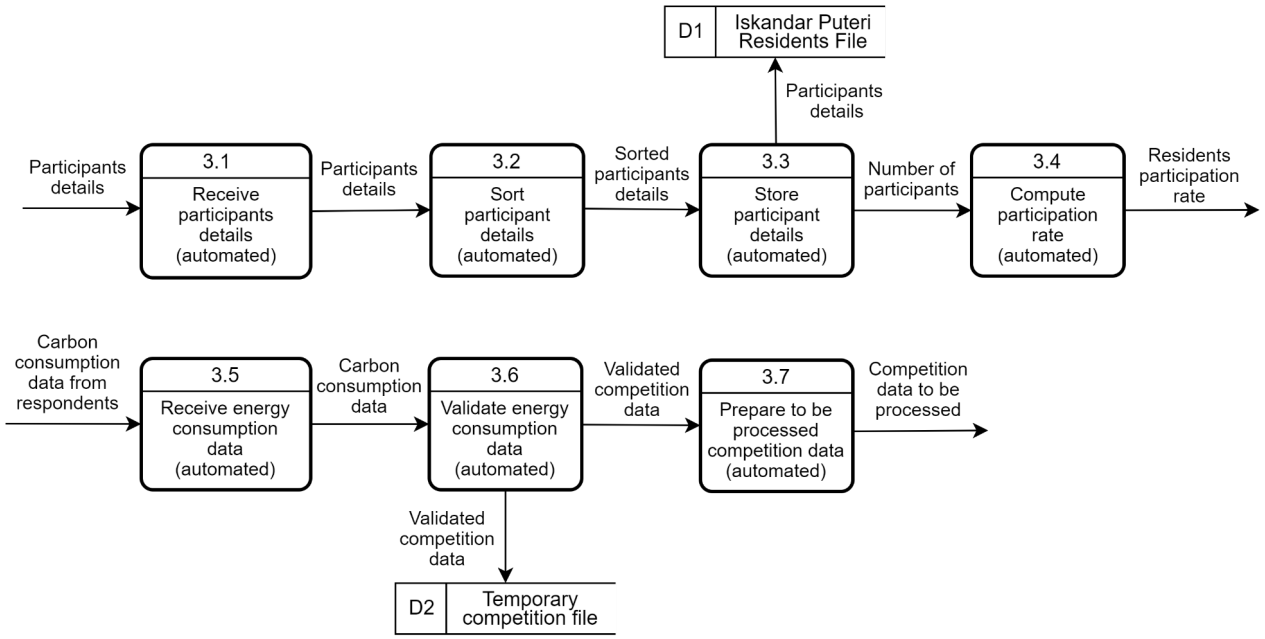


Figure 5.1.5 Child Diagram for Process 3

Based on Figure 5.1.5, managing community data (Process 3) begins with receiving both participants details and carbon consumption data automatically. Then, the participant details will be sorted based on specific order such as by name or area. Once the participants' details are sorted, the details will be stored at the Iskandar Puteri Residents file (Data Store 1). Then, the number of participants will be extracted to compute the participation rate. On the other hand, validation of energy consumption data will repeat to ensure all the data are valid. Then, the data will be prepared so it can be used for further processing.

5.1.5.1 PROCESS SPECIFICATION FOR PROCESS 3 : Manage Community Data

Number	3
Name	Manage community data
Description	A process that is used to manage the participants' details and energy consumption data. It will validate the energy consumption data to ensure there is no error for automated computation. On the other hand, the participants' details will be sorted and stored securely in a data store.
Input Data Flow	1. Participants' details from MBIP consultant 2. Carbon consumption data from respondents MBIP consultant
Output Data Flow	1. Participants' details to Data Store 1 2. Validated competition data to Data Store 2 3. Competition data to be processed flows to Process 4 4. Residents participation rate flows to Process 5
Type of Process	[✔] Online [ ] Batch [ ] Manual

Process Logic	DO WHILE Participants' details AND Energy consumption data are received
	IF data received is Participants' details
	WHILE participants' detail is not sorted
	THEN sort the participants' detail
	THEN store the participants' detail
	END WHILE
	THEN compute participation rate based on number of participants
	ELSE IF data received is Energy consumption data
	WHILE energy consumption is not validated
	THEN validate energy consumption data
	THEN prepare to be processed competition data
	END IF
	ELSE
	Display INVALID DATA
	ENDIF
	ENDDO

Refer to Name	[✔] Structured English [ ] Decision Table [ ] Decision Tree
Unresolved Issue	1. Is there any method to handle invalid data? 2. What is the standardized formula to compute participation rate?

Structured English :

```
DO WHILE Participants' details AND Energy consumption
data are received
    IF data received is Participants' details
      WHILE participants' detail is not sorted
        THEN sort the participants' detail
         THEN store the participants' detail
      END WHILE
      THEN compute participation rate based on number of
participants
    ELSE IF data received is Energy consumption data
      WHILE energy consumption is not validated
        THEN validate energy consumption data
        THEN prepare to be processed competition data
      END IF
    ELSE
      Display INVALID DATA
    ENDIF
ENDDO
```

Figure 5.1.3.1 Structured English for Process 1 (Submit Competition Data)

For Process 3, we will use Structured English as our process specification format. This is because the sub processes involved are step-by-step. Moreover there will be IF conditions to check the data received and loops to monitor the data validation. Therefore, Structured English is suitable to be used in Process 3 to show the processes.

5.1.6 CHILD DIAGRAM DFD LEVEL-1 FOR PROCESS 4 : Analyze Carbon Consumption Data

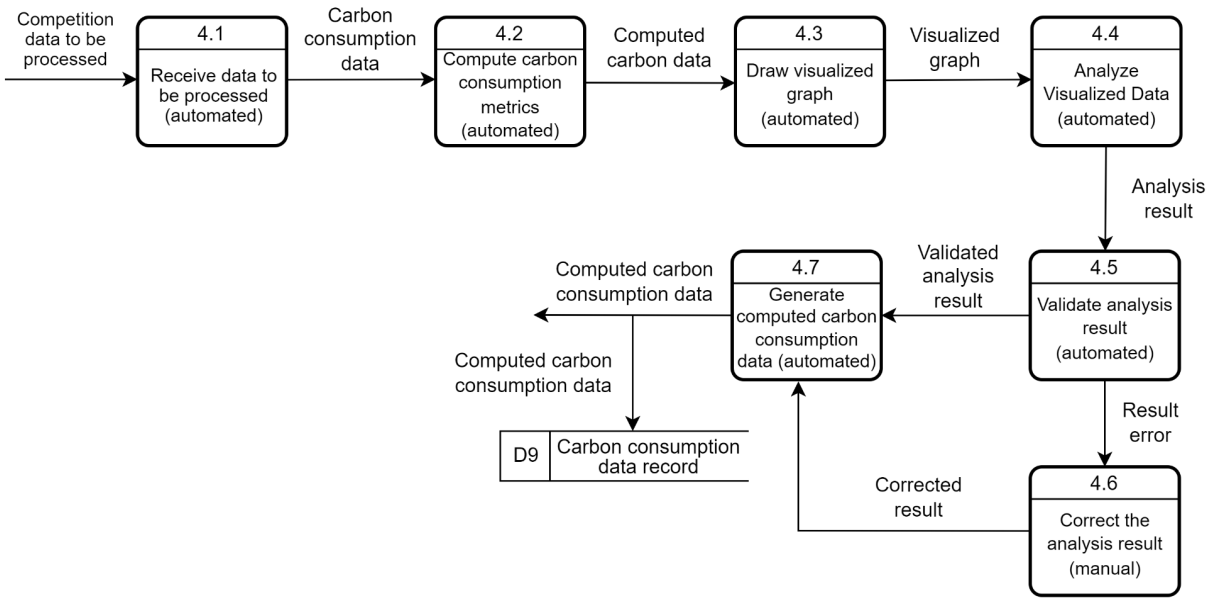


Figure 5.1.6 Child Diagram for Process 4 (Analyze Carbon Consumption Data)

For process 4 (Analyze Carbon Consumption Data), the analysis begins with receiving carbon consumption data automatically in step 4.1. This data is then processed to compute carbon consumption metrics which are further used to draw a visualized graph. The graph is then analyzed to generate the analysis result, which is subsequently validated. If there are errors in the results, a correction process is manually undertaken. Finally, the validated data is used to generate a corrected carbon consumption data report , which is then recorded in the Carbon Consumption Data Record (D9).

5.1.6.1 PROCESS SPECIFICATION FOR PROCESS 4 :
Analyze Carbon Consumption Data

Number	4
Name	Analyze Carbon Consumption Data
Description	This process involves the analysis of carbon consumption data to identify trends, patterns, and opportunities for carbon footprint reduction within the Iskandar Puteri area. The analysis is conducted using batch processing, which allows for the handling of large datasets.
Input Data Flow	1. Competition data to be processed
Output Data Flow	1. Computed carbon consumption data
Type of Process	[ ] Online [✔] Batch [ ] Manual

Process Logic	DO WHILE Data to be processed is received
	Compute carbon consumption metrics
	Draw visualized graph
	IF visualized data is not analyzed
	THEN Analyze Visualized Data
	ELSE Validate analysis result
	ENDIF
	WHILE analysis result is wrong
	THEN Correct the analysis result
	END WHILE
	Generate computed carbon consumption data
	ENDDO

Refer to Name	[✔] Structured English [ ] Decision Table [ ] Decision Tree
Unresolved Issue	1. Is it necessary to define methods for handling data that cannot be validated or corrected? 2. Should a procedure be established to ensure that data remains accurate as new information becomes available?

Structured English :

```
DO WHILE Data to be processed is received
  Compute carbon consumption metrics
  Draw visualized graph
  IF visualized data is not analyzed
    THEN Analyze Visualized Data
  ELSE Validate analysis result
  ENDIF
  WHILE analysis result is wrong
    THEN Correct the analysis result
  END WHILE
  Generate computed carbon consumption data
ENDDO
```

Figure 5.1.6.1 Structured English for Process 4 (Analyze Carbon Consumption Data)

For process 4, we use Structured English to show the sub processes involved. First, we will continue the process 4 if the data to be processed are received successfully. Then, there is IF condition to check whether the visualized data has been analyzed or not. Then, there is a WHILE loop to keep checking the analysis result to ensure there are no errors at all.

5.1.7 CHILD DIAGRAM DFD LEVEL-1 FOR PROCESS 5 : Generate Participation Report

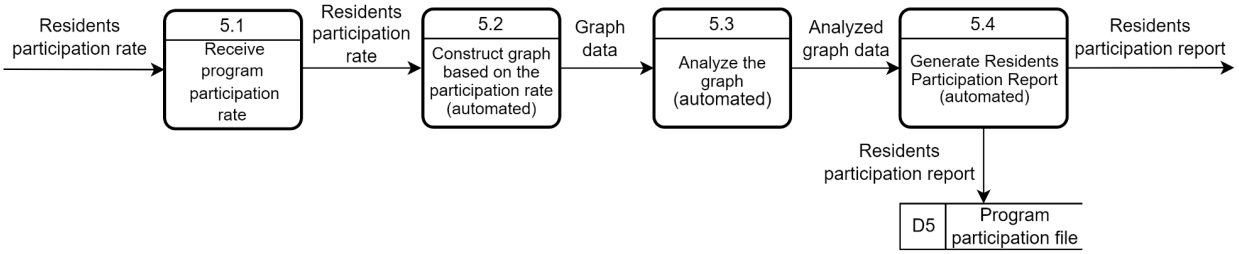


Figure 5.1.7 Child Diagram for Process 5 (Generate Participation Report)

Based on Figure 5.1.7, generating participation report (process 5) begins with receiving program participation rate from Process 4. Then, it will construct a graph based on the participation rate so it will be easier to analyze. Then, the graph will be analyzed and the resident participation report will be generated once it gets the analyzed graph data.

5.1.7.1 PROCESS SPECIFICATION FOR PROCESS 5 : Generate Participation Report

Number	5
Name	Generate Participation Report
Description	This process will process the Iskandar Puteri residents' participation rate by constructing graphs, analyzing graphs and finally generating the residents' participation report.
Input Data Flow	1. Residents' participation rate
Output Data Flow	1. Residents' participation report
Type of Process	[✔] Online [ ] Batch [ ] Manual

Process Logic	Receive program participation rate
	Construct graph based on the participation rate
	Analyze the graph
	IF Analyzed graph data
	THEN Generate residents participation report
	ELSE
	Wait until the analyzed graph data is prepared
	ENDIF

Refer to Name	[✔] Structured English [ ] Decision Table [ ] Decision Tree
Unresolved Issue	1. Are there any graphing tools employed? 2. What patterns or trends are considered in the analysis? 3. How does the system handle the delay in the data preparation process?

\

Structured English :

```
READ program participation rate
IF program participation rate is received
    Construct graph based on the participation rate
    Analyze the graph
    IF Analyzed graph data is received
        THEN Generate residents participation report
    ELSE
        Wait until the analyzed graph data is prepared
    ENDIF
ELSE
    Wait for the program participation rate to be sent
ENDIF
```

Figure 5.1.7.1 Structured English for Process 5 (Submit Competition Data)

For Process 5 (Generate Participation Report), we choose structured English as the technique of the process specification. This is because we add a IF condition to check whether all the necessary data such as program participation rate data and analyzed graph data are received or not. IF the program participation rate is received, then process 5 will proceed. On the other hand, IF the analyzed graph data is received, the residents participation report will be generated.

5.1.8 CHILD DIAGRAM DFD LEVEL-1 FOR PROCESS 6 : Generate Competition Report

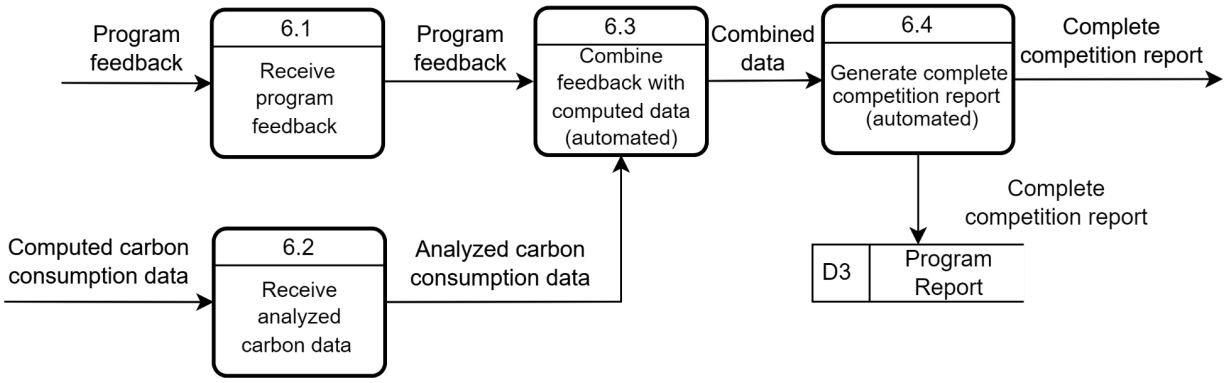


Figure 5.1.8 Child Diagram for Process 6 (Generate Competition Report)

Based on Figure 5.1.8, Process 6 will begin with receiving the program feedback from the MBIP planning department and receiving the analyzed carbon data from Process 4. Then, the program feedback and computed data will be combined together to generate a complete competition report and sent to MBIP planning department and to be stored at Data Store 3.

5.1.8.1 PROCESS SPECIFICATION FOR PROCESS 6 : Generate Competition Report

Number	6
Name	Generate Competition Report
Description	After receiving the program feedback from the MBIP planning department and analyzed data, the system will automatically generate a complete competition report which will make it easier to understand the whole program.
Input Data Flow	3. Computed carbon consumption data 4. Program Feedback
Output Data Flow	5. Complete competition report
Type of Process	[✔] Online [ ] Batch [ ] Manual
Process Logic	IF Program Feedback AND Computed carbon consumption data are received THEN Combine feedback and computed carbon consumption data THEN Generate competition report THEN Store the data at program report data store ELSE Wait until all the data are prepared
Refer to Name	[✔] Structured English [ ] Decision Table [ ] Decision Tree
Unresolved Issue	3. Is there any method that handles errors if a report cannot be generated successfully? 4. Is there any validated process after the combination of the data to ensure a compatible format?

Structured English :

```
READ Program feedback
READ Computed carbon consumption data
IF Program Feedback AND Computed carbon data are received
    THEN Combine feedback and computed carbon
consumption data
    THEN Generate competition report
    THEN Store the report at program report data store
ELSE
    Wait until all the data are prepared
```

Figure 5.1.8.1 Structured English for Process 6 (Generate competition report)

For Process 6 (Generate Competition Report), we choose structured English as the technique of the process specification. This is because we add a IF condition to check whether all the necessary data such as program feedback and computed carbon data are received or not. If the condition is met, then a competition report will be generated and the report will be stored at the program report data store.

5.2 SUMMARY

Phase 3 is mainly focused on defining enhanced to-be processes for the Carbon Cut Off Pro system through detailed physical data flows diagrams, structure charts and process specifications.

The physical DFDs developed help us to map out the improved flow of data between external entities, key processes and data stores. Additional temporary data stores have been incorporated between certain processes to allow for more seamless dataflow and tracing purposes. Automated processes such as form validation, data checking have also been added to the DFDs to reduce some overhead of manual processes that occurred in the current system. This will contribute towards smoothing and optimizing the carbon data monitoring flows.

Next, the structure charts have been created to decompose the system into subprocesses and steps. From the structure charts, we can analyze the interdependencies between the high-level modules towards low-level modules. This will help us in developing a system with high cohesion and low coupling. Moreover, the process specification elaborates each process workflow further by specifying the conditions and loops involved by using Structure English. It will help us to outline the process expectations comprehensively.

In summary, the techniques like physical DFDs, structure charts and process specifications have been adopted in this phase to establish a more robust foundation for our Carbon Cut Off Pro system. The designs will focus more on automation activities to address the limitations in the current manual approaches.

6. REFERENCES

- *Logical vs. Physical Data Flow Diagram*. (n.d.). Lucidchart. https://www.lucidchart.com/pages/data-flow-diagram/logical-vs-physical-data-flow-diagram

- *Software Engineering Structure Charts*. (2023, April 5). GeeksforGeeks. https://www.geeksforgeeks.org/software-engineering-structure-charts/

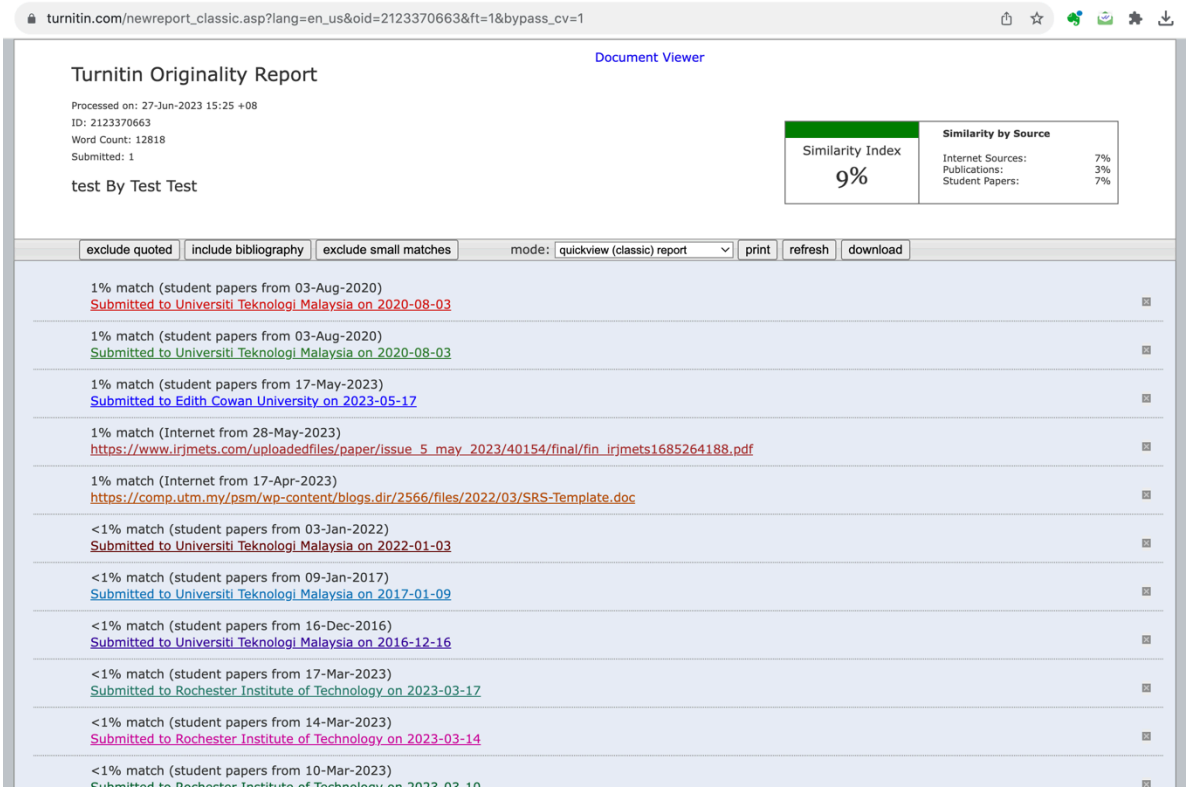
- Process Specifications and Structured Decisions. (n.d.). In *Kendall and Kendall* (9th ed., pp. 235–238).

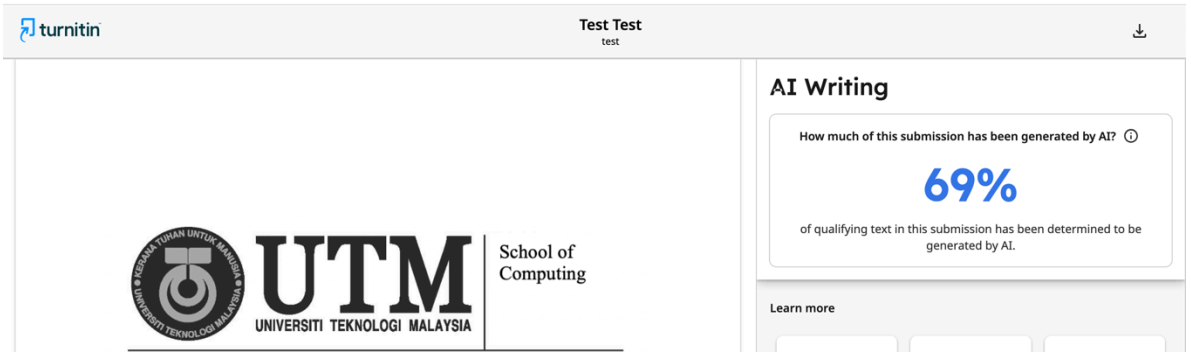
- *Difference between Structure chart and Flow chart*. (2020, April 22). GeeksforGeeks. https://www.geeksforgeeks.org/difference-between-structure-chart-and-flow-chart/

- *Logical vs Physical Data Flow Diagrams*. (n.d.). https://www.visual-paradigm.com/guide/data-flow-diagram/logical-vs-physical-data-flow-diagrams/

7. Appendices (Compulsory)

- ***Appendix A: Originality/Similarity Report***
  - *Attach the originality/ similarity report (.pdf file) from Turnitin checking.*
  - *UTM teaching and learning best practice for plagiarism policy is similarity index must less than (=<) 20%*





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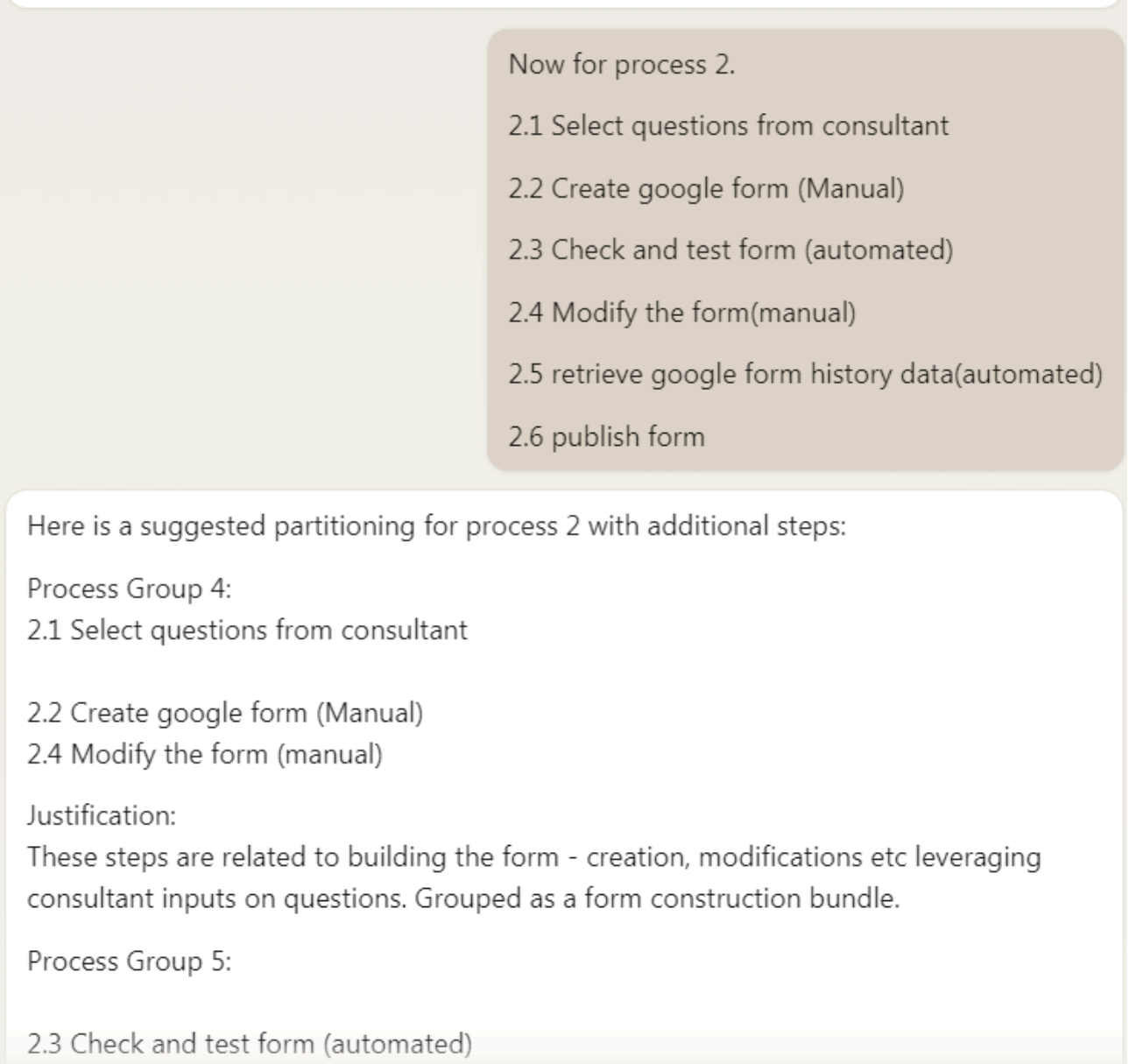
- ***Appendix B: Evidence of Generative AI tools usage***



Example of Screenshot Generative AI in collecting ideas for Physical DFD

Example: URL
Chat GPT Link