



DAT601 ASSIGNMENT 1

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Assignment 1 Part 1:

QUERIES

Query 1:

```
SELECT VendorID, ProductName
FROM Product
WHERE VendorID <> 'DLL01';
```

	VendorID	ProductName
1	BRS01	8 inch teddy bear
2	BRS01	12 inch teddy bear
3	BRS01	18 inch teddy bear

Query 2:

```
SELECT ProductName, ProductPrice
FROM Product
WHERE ProductPrice BETWEEN 5.00 AND 10.00;
```

	ProductName	ProductPrice
1	8 inch teddy bear	5.99
2	12 inch teddy bear	8.99

Query 3:

```
-- QUERY 3
SELECT ProductName, ProductPrice
FROM Product
WHERE (VendorID = 'DLL01' OR VendorID = 'BRS01')
AND ProductPrice >= 10.00;
```

	ProductName	ProductPrice
1	18 inch teddy bear	11.99

Query 4:

```
-- QUERY 4
SELECT AVG(ProductPrice)
AS AverageProductPrice
FROM Product;
```

	AverageProductPrice
1	6.061428

Query 5:

```
-- QUERY 5
SELECT COUNT(*) AS CustomerAmount
FROM Customer;
```

	CustomerAmount
1	5

Query 6:

```
-- QUERY 6
SELECT COUNT(CustEmail) AS CustWithEmails
FROM Customer;
```

	CustWithEmails
1	3

Query 7:

```
-- QUERY 7
SELECT COUNT(ProductID) AS ProductType, AVG(ProductPrice) AS AveragePrice, MIN(ProductPrice) AS MinPrice, MAX(ProductPrice) AS MaxPrice
FROM Product;
```

	ProductType	AveragePrice	MinPrice	MaxPrice
1	7	6.061428	3.49	11.99

JOINS

Join 1:

```
-- JOIN 1
SELECT Vendor.VendorName, Product.ProductName, Product.ProductPrice
FROM Vendor
JOIN Product ON Vendor.VendorID = Product.VendorID;
```

	VendorName	ProductName	ProductPrice
1	Bears R Us	8 inch teddy bear	5.99
2	Bears R Us	12 inch teddy bear	8.99
3	Bears R Us	18 inch teddy bear	11.99
4	Doll House Inc.	Fish bean bag toy	3.49
5	Doll House Inc.	Bird bean bag toy	3.49
6	Doll House Inc.	Rabbit bean bag toy	3.49
7	Doll House Inc.	Raggedy Ann	4.99

Join 2:

```
-- JOIN 2
SELECT Product.ProductName, Vendor.VendorName, Product.ProductPrice, OrderItem.Quantity
FROM OrderItem
JOIN Product ON OrderItem.ProductID = Product.ProductID
JOIN Vendor ON Product.VendorID = Vendor.VendorID
WHERE OrderID = '20007';
```

	ProductName	VendorName	ProductPrice	Quantity
1	18 inch teddy bear	Bears R Us	11.99	50
2	Fish bean bag toy	Doll House Inc.	3.49	100
3	Bird bean bag toy	Doll House Inc.	3.49	100
4	Rabbit bean bag toy	Doll House Inc.	3.49	100
5	Raggedy Ann	Doll House Inc.	4.99	50

SUBQUERIES:

Subquery 1:

```
SELECT CustName, CustContact
FROM Customer
Where CustID IN (
    SELECT CustID
    FROM OrderEntry
    WHERE OrderID IN (
        SELECT OrderID
        FROM OrderItem
        WHERE ProductID = 'RGAN01'
    )
);
```

	CustName	CustContact
1	Fun4All	Denise L. Stephens
2	The Toy Store	Kim Howard

Subquery 2:

```
SELECT
    CustName,
    CustCity,
    COUNT (OrderID) AS AllOrders
FROM Customer
LEFT JOIN OrderEntry ON Customer.CustID = OrderEntry.CustID
GROUP BY Customer.CustName, Customer.CustCity
ORDER BY Customer.CustName;
```

	CustName	CustCity	AllOrders
1	Fun4All	Auckland	1
2	Fun4All	Nelson	1
3	Kids Place	Nelson	0
4	The Toy Emporium	NULL	0
5	The Toy Store	Christchurch	1
6	Village Toys	Wellington	2

Combined Query:

```
-- COMBINED QUERY 1
SELECT C.CustName, C.CustContact, C.CustEmail
FROM Customer C
WHERE C.CustCity IN ('Nelson', 'Wellington')

UNION

SELECT C.CustName, C.CustContact, C.CustEmail
FROM Customer C
WHERE C.CustName = 'Fun4All'

ORDER BY C.CustName, C.CustContact;
```

	CustName	CustContact	CustEmail
1	Fun4All	Denise L. Stephens	dstephens@fun4all.co.nz
2	Fun4All	Jim Jones	jones@fun4all.co.nz
3	Kids Place	Michelle Green	NULL
4	Village Toys	John Smith	sales@villagetoys.co.nz

VIEWS:

View 1:

```
GO
CREATE VIEW vProductCustomer AS
SELECT
    Customer.CustID,
    Customer.CustName,
    Customer.CustContact,
    OrderItem.ProductID
FROM Customer
JOIN OrderEntry ON Customer.CustID = OrderEntry.CustID
JOIN OrderItem ON OrderEntry.OrderID = OrderItem.OrderID
JOIN Product ON Product.ProductID = OrderItem.ProductID

GO

SELECT CustName, CustContact
FROM vProductCustomer
WHERE ProductID = 'RGAN01'
```

	CustName	CustContact
1	Fun4All	Denise L. Stephens
2	The Toy Store	Kim Howard

View 2:

```
INSERT INTO Customer(CustID, CustName, CustPhone)
VALUES ('100000000', 'The Toy Emporium', '09-546-8552');

GO
CREATE VIEW vCustomerMailingLabel AS
SELECT Customer.CustName, Customer.CustAddress, Customer.CustCity, Customer.CustPhone
FROM Customer;

GO

CREATE VIEW vFilterCustomer AS
SELECT CustName, CustAddress, CustCity, CustPhone
FROM vCustomerMailingLabel
WHERE CustAddress IS NOT NULL AND CustCity IS NOT NULL;

GO

SELECT CustName, CustAddress, CustCity, CustPhone
FROM vFilterCustomer;
```

	CustName	CustAddress	CustCity	CustPhone
1	Village Toys	200 Oak Lane	Wellington	09-389-2356
2	Kids Place	333 Tahunanui Drive	Nelson	03-545-6333
3	Fun4All	1 Sunny Place	Nelson	03-548-2285
4	Fun4All	829 Queen Street	Auckland	09-368-7894
5	The Toy Store	50 Papanui Road	Christchurch	04-345-4545

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Assignment 1 Part 2

1. Description of Conceptual Modelling:

Conceptual Modelling is the implementation of creating a simplified representation of a complicated system, which allows it to be more understandable and manageable. This represents the first layer of data modelling and ensures that the system reflects the requirements of the business accurately.

The Extended Chen Entity-Relationship Diagram (ERD) is a technique that goes beyond the original Chen ER model. The extended version utilizes more features include subtypes (ISA relationships), weak entities, multi-valued attributes, associative entities. Etc.

2. Components of an ERD:

1. Entities

Entities are definable things that can have data stored within it. Examples could be a customer, product etc. Entities are shown as a rectangle and may have different views depending on the type:

- **Strong entity:** the standard entity type that can act as its own independent state
- **Weak entity:** this is an entity that cannot independently exist and relies on the owner entity.
- **Associative entity:** this is an entity used for many-to-many relationships

2. Attributes

These define the traits of an entity. The attributes are shown as ovals in diagrams and are connected to their parent entities using a connected line.

Some attributes include:

- **Simple attributes:** these are very concise traits (e.g., Name)
- **Key Attributes:** these represent an attribute that uniquely identifies an entity (e.g., CustomerID)

- **Composite attributes:** these are traits that can be divided into multiple simpler attributes (e.g., “Address” can be broken down into ‘street’, ‘city’, ‘zip code’ etc.)
- **Derived Attributes:** These are attributes which values need to be calculated from other attributes to get a result (e.g., Age is derived from dateOfBirth)
- **Multi-valued attributes:** these can have more than one value/results for an entity (e.g., Hobby (people usually have more than one))

3. Keys

Keys are a way to uniquely identify an entity from a set. Key attributes are represented by an oval (same as attributes) but the text of the attribute is underlined to differentiate it.

Some keys include:

- **Candidate key:** This is a simple/composite key that is unique as no two rows in the table would have the same value
- **Composite key:** this composes two or more attributes
- **Primary key:** This is a key that is a non-null value to represent identification for a whole entity
- **Foreign key:** These are keys that an entity can reference a primary key from another entity

4. Relationships

Relationships show the connections between entities – these are represented by diamonds (between the lines connected for two entities) and can have attributes of their own.

Relationships include cardinality and participation, which defines how the entities are linked and whether participation is necessary.

- **Cardinality:** Regards the number of times an instance in one entity can relate to instances of another entity (One customer can purchase many products – many products can be purchased by one customer)
- **Participation:** Explains the level of dependency another entity has with a relation with another entity (A bill cannot be created without a purchase being made)

5. Relationship Degrees

Relationship degrees mean the number of entities participated in the relationship set

- **Unary Relationship:** Only one entity is participating as a relationship (also known as a recursive relationship)
- **Binary Relationship:** Two entities are involved in the set of relationships
- **Ternary Relationship:** Three entities are participating in the relationship created
- **N-ary Relationship:** This is a form of relationship when the **n** number of total entities are participating – this could have up to 5+ entities relating.

Bhagwhat, S. (2022, June 23). *Degree of relationship in DBMS*. Scaler Topics.

<https://www.scaler.com/topics/degree-of-relationship-in-dbms/>

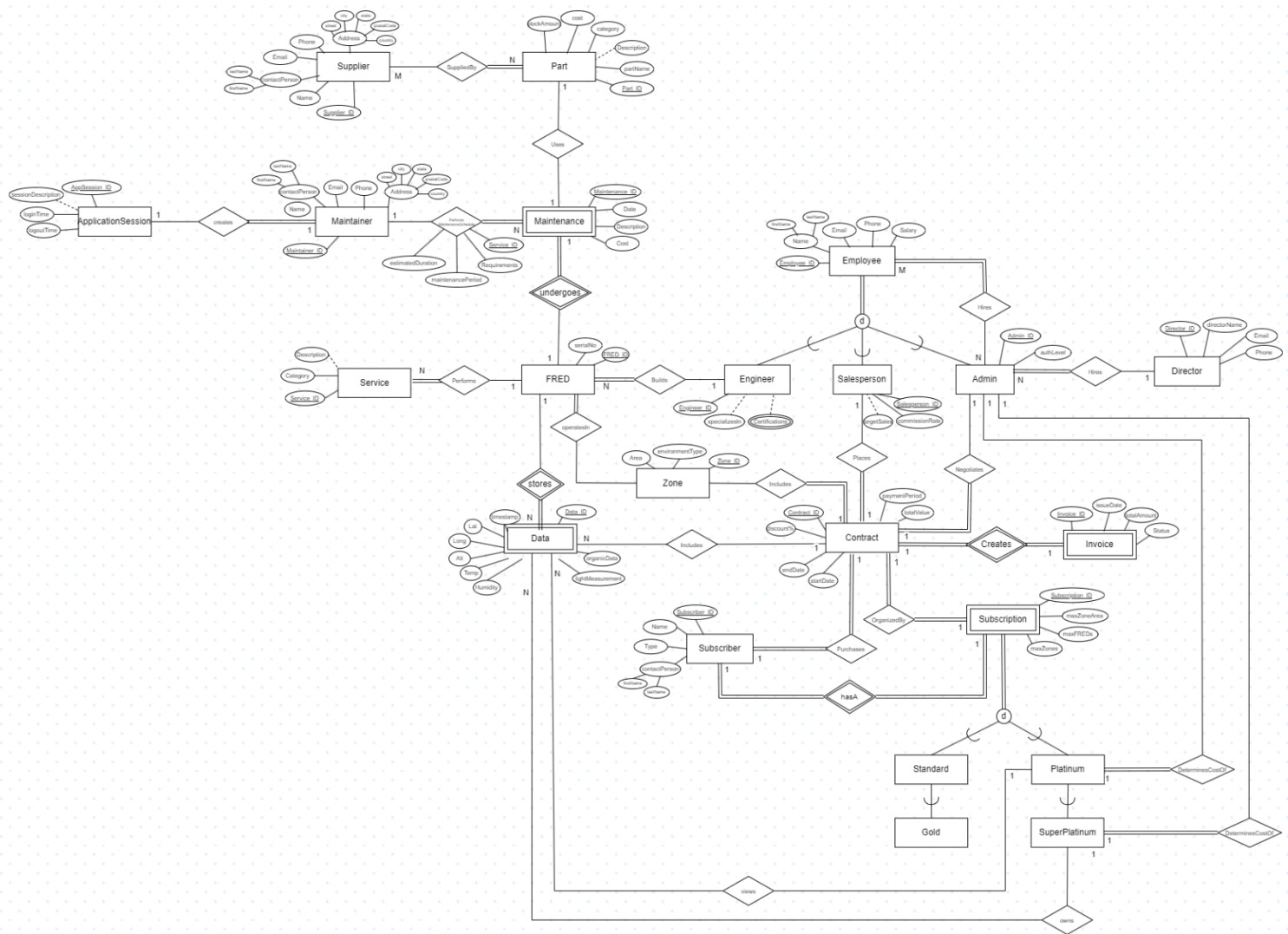
Rodina, D. (n.d.). *Composite key (entity-relationship diagram)*. Software Ideas Modeler – diagramming case tool.

<https://www.softwareideas.net/composite-key>

Lucidchart (n.d.). *What is an entity relationship diagram (ERD)?*.

<https://www.lucidchart.com/pages/er-diagrams>

Chen Conceptual Entity Relationship Model



[file for this diagram is in GITHUB]

Reasoning and Purpose of all Parts of the Model:

This ERD model was created using the Chen notation – utilizing this style made it easier to visualize the system involving drone services, maintenance, staff roles etc.

Each component of the model – entities, attributes, relationships, keys, ISA hierarchies etc. – have been designed to reflect the required business logic.

Entities:

1. FRED

This represents the drone devices that are used to carry out services and data collection. The purpose of this is being the operational unit of the business.

2. Data (Weak Entity)

This is the results that have been collected from the FREDs – this includes (but not limited to) images, analytics etc. The purpose of this is used for zone records, reporting and analysis.

3. Contract

This is the mutual agreement between the ParkWorks company and the subscriber whose purchasing services. The purpose of the contract is to solidify the use of a FRED for a subscribing company.

4. Subscription

Service tier classifications that are implemented using ISA (e.g., Standard ISA SubscriptionType). The purpose of this is to define the levels of access that the contract withholds (in terms of service)

5. Zone

These are areas used to categorize specific locations that FREDs can perform within to do particular services. The purpose of this is to optimize service routing.

6. Service

This defines the activities that are implemented by the FRED drones, such as tree trimming, track clearing, grass mowing, planting etc. The purpose of this is to show the link between what was agreed in the contracts and what the required operations are.

7. Maintenance (Weak Entity)

This is used to log specific maintenance actions that is done for a FRED, whether its cleaning, software updates or fixing/replacing a part. The purpose of this is to service the FREDs to maintain its longevity to perform tasks – through this, the maintainer would log a record to track drone upkeep history.

8. Maintainer/Engineer/Admin/Director/Salesperson

These each represent staff/third party roles, each equipped with different responsibilities. The purpose of this is to show employee organization and task delegation. For example, engineer and salesperson are visualized in the diagram using ISA hierarchy (e.g., Engineer ISA Employee)

Directors are used to hire admin, and admin hire employees. Maintainers are used to maintain/service the FREDs.

Engineers design and build the FREDs and salespersons use marketing specialties to advertise the FREDs and initialize contracts, where admins finalize them.

9. MaintenanceSchedule (PerformsMaintenanceSchedule) – Relationship with Entities

This defines the maintenance operations and what need to be done. The purpose of this is to track future tasks and enable the organization of services that need to be carried out.

10. ApplicationSession

This represents the active use of the maintenance system and shows how it was used by maintainers. The purpose of this is to monitor system access and usage.

11. Subscriber

This represents the organization that signs up for a service and agrees to a contract. The purpose of this is to identify the individuals who are entitled to levels of service.

12. Part

This defines the components used in the repair and maintenance of a drone. The purpose of this is to track items for a FRED.

13. Supplier

This is a third part organization that provides the parts used in the drone maintenance. The purpose of this is to represent the companies that can restock the parts used.

14. Invoice

This represents the bill document given to a subscriber, requesting payment for the contracted services. The purpose of this is to provide a financial audit for the services done by a FRED.

Relationships and Design:

1. FRED performs Service

This shows the drones are responsible for doing the services – a service **MUST** be performed by a drone. (One FRED can perform zero to many services)

2. FRED OperatesIn Zone

A FRED operates in particular zones that they have been delivered to based on contracts that have been finalized from subscribers. (One or more FREDs could operate in 1 or more zones)

3. Zone LocatedIn Region

This shows the hierarchical relationship between the two entities – regions can have one or more zones within them. Every zone **MUST** belong to a region (Zero to many zones may be located in a region)

4. Director hires Admin / Admin Hires Employee

This represents authority hierarchy. Admins can't exist without directors hiring and employees won't be there without an admin hiring them. (Many directors can hire many administrators – One or more administrators can hire one or more employees)

5. Contract Includes Zone

This indicates where the contracted service will be delivered to (One contract includes one or more zones)

6. Contract overlooks Data

A contract tells the types of data that needs to be collected or managed depending on what the agreement is. (One contract overlooks one or more sets of data from a FRED)

7. FRED undergoes Maintenance

Each FRED is subject to scheduled maintenance to checkup on its performance and whether it needs to be cleaned, fixed etc. (One or more FREDs undergo one or more maintenance sessions in their lifetime)

8. Maintainer PerformsMaintenanceSchedule (for) Maintenance

A maintainer carries out the maintenance tasks that need to be done to FRED units. (Many maintenance sessions can be carried out by a maintainer). Each maintainer needs to follow the schedule which outlines when services need to be done to FREDs. (a maintainer follows a maintenance schedule)

9. Maintainer creates ApplicationSession

The maintainer logs application sessions and gets monitored when performing entries on the application. (A maintainer creates an application session)

10. Maintenance uses Part

Parts may be used during the maintenance sessions for FREDs (One maintenance session may use zero to many part components for FRED maintenance services)

11. Part SuppliedBy Supplier

Each part used in maintenance needs to be supplied by third-party suppliers. (One or more parts have been supplied by one or more suppliers)

12. Engineer builds FRED

An engineer designs and assembled FRED drones. (One engineer can build one or many FREDs)

13. Engineer ISA Employee

An engineer is a subtype of an employee within ParkWorks.

14. Salesperson ISA Employee

A salesperson is a subtype of an employee within ParkWorks.

15. Admin negotiates Contract

The administrators handle the negotiation of the service contracts with subscribers, finalizing the details that have been initialized by the salesperson. (One admin negotiates many contracts – one contract is negotiated by one admin)

16. Admin determinesCost of Platinum/SuperPlatinum

Admins have the ability to determine details and cost of the platinum and super platinum subscriptions, given a subscriber has chosen one of those types. (An admin determinesCost of a platinum/superplatinum subscription)

17. Platinum Views Data

Subscribers who purchased a contract with a platinum subscription can view data that's been made by FRED drones. (A platinum subscription views many sets of data)

18. SuperPlatinum Owns Data

Subscribers who have purchased a contract with a super platinum subscription has the ability and right to own the data that's been created by the FRED drones (A super platinum subscription owns many sets of data)

19. Salesperson places Contract

The salesperson processes the placement of contracts between the company and the subscriber/s involved – the starting point before its passed onto the admin to finalize. (One salesperson can place multiple contracts – but one contract is placed by one salesperson)

20. Contract OrganizedBy SubscriptionType

Each contract is under a certain subscription type – this determines the pricing and feature capabilities of the contract requirements (One contract is organized by one subscription type)

21. Subscriber purchase Contract

Subscribers may agree to purchase a contract to be able to utilize drone services. (A subscriber purchases one contract)

22. Subscriber hasA Subscription

This shows that the subscriber would also be linked to a specific subscription type, in relation to the contract – including this reduces ambiguity and confirms they would be associated with a subscription. (A subscriber has a (singular) subscription)

23. Contract creates Invoice

When a contract is initialized, it creates an invoice that bills the subscriber for the services performed. (One contract creates one invoice)

How I used 'EXTENDED' notation for the ERD:

1. ISA

I used ISA for the salesperson and engineer entities as they are a subtype of 'employee'. This was used as it supports inheritance.

2. Weak entities

I used these as it aligns with data normalization – these entities cannot exist independently and relies on the parent entities (e.g., Data cannot exist without FREDs)

3. Associative entities

The contract was modelled as associative as I had linked subscriber, SubscriptionType, zone, salesperson and admin.

Principles of Data Management:

1. Entity Integrity:

Each entity has a defined primary key, which encourages the use of unique identification.

2. Data accuracy:

The attributes used for each entity showcases completeness.

3. Normalization:

This model attempts to avoid duplication through entities and weak entities.

4. Scalability:

The use of ISA hierarchies supports system scalability without having to do major changes in the display.

Data Dictionary:

Table 1: Document Entities

Entity Name	Description	Aliases	Occurrence
FRED	A 'Free Roaming Environmental Drone' that is used for maintenance and collects sensor data	Drone, Robot	One record for each FRED drone that are deployed by ParkWorks
Contract	An arrangement between ParkWorks and a client for the FRED services	Agreement, Document, Subscription	One record for every subscription service account with a client
Employee	A person that has been employed by ParkWorks	Staff, Worker	One record for every ParkWorks worker
Salesperson	An employee that sells subscriptions	Sale representative	One record for each employee who sells subscription
Engineer	An employee that designs and builds FREDs	Designer, Builder	One record for each employee that are capable of technical engineering
Executive Admin	An employee that has administrative capabilities	Administrator	One record for each employee that can manage contracts and change prices
Director	A high level member that is responsible for hiring admins	Executive	One record for each director that hires admins A system may have one or more directors
ApplicationSession	This represent the usage instance of the application that is designed for the maintainer.	App session, app usage	One record for each session that is entered by a maintainer
Region	Represents a geological area that contains zones for FREDs to roam in.	Area	One record for each region that has zones and has FREDs occupying it. A region may exist with or without any assigned zones.
Subscriber	Someone who contracts ParkWorks for FRED services	Customer, Client, End User	One record for every client that has subscribed to ParkWorks services
Subscription	A category of subscription with different tiers (standard, gold, platinum, super platinum)	Plan	One record for each subscription plan (standard, gold, platinum, super platinum)

Standard	The first subscription type with the lowest features, including a maximum of ONE FRED, ONE Zone with maximum area being 10 hectares	Tier 1/Subscription Plan 1	One record for the subscriber who chose the standard plan for the contract
Gold	The second subscription type with the generic features, including a maximum of THREE FREDS that can do THREE services in THREE zones. The maximum area being no more than 100 hectares	Tier 2/Subscription Plan 2	One record for the subscriber who chose the gold plan for the contract
Platinum	The third subscription type with higher features, including being able to use as many FREDS with as many zones and services. They are able to receive data for their zones.	Tier 3/Subscription Plan 3	One record for the subscriber who chose the platinum plan for the contract
Super Platinum	The forth subscription type with the highest features, including exclusive control of any FREDS, having as many zones and services AND are able to view the location of FREDS using an application	Tier 4/Subscription Plan 4	One record for the subscriber who chose the super platinum plan for the contract
Zone	An area where FREDS operate and gather data	Area, Section	One record for each of the boundaries where FREDS are released
Part	Component used to design and put together a FRED	Element, segment	One record for each part type used in a FRED
Supplier	Organization that provides the parts necessary for FREDS	Distributor, Seller, Provider	One record for each organization that supplies parts for a FRED
Service	A task that FREDS can do	Resource, Solution, Utility	One record for each type of service FREDS can do
Maintenance	A record of service that has been done for a FRED	Conservation, Care, Service	One record for each maintenance activity that a FRED has performed
Maintainer	A third-party company that performs maintenance for FREDS	Service Provider	One record for each company that maintains FREDS
Data	Environment data gathered by FREDS	Input, Details, Statistics	One record for a set of environmental data collected by a FRED
Invoice	A bill for subscription services	Bill, Account, Charge	One record for each bill period for a contract

Table 2: Document Relationships/Specializations- Generalizations

Entity Name	Cardinality	Participation	Relationship	Participation	Cardinality	Entity Name
FRED	N	Total	OperatesIn	Partial	M	Zone
FRED	1	Total	Stores	Total	N	Data
FRED	1	Total	Performs	Total	N	Service
FRED	1	Total	Undergoes	Total	1	Maintenance
Part	N	Total	SuppliedBy	Partial	M	Supplier
Maintenance	1	Partial	Uses	Partial	1	Part
Contract	1	Total	OrganizedBy	Partial	1	Subscription
Contract	1	Partial	Overlooks	Partial	N	Data
Contract	1	Total	Creates	Total	1	Invoice
Contract	1	Total	Includes	Partial	N	Zone
Subscriber	1	Partial	Purchases	Total	1	Contract
Subscriber	1	Total	HasA	Total	1	Subscription
Engineer	1	Partial	ISA (Specialization)	Total	1	Employee
Salesperson	1	Partial	ISA (Specialization)	Total	1	Employee
Admin	1	Partial	ISA (Specialization)	Total	1	Employee
Admin	N	Partial	Hires	Total	M	Employee
Director	1	Partial	Hires	Total	N	Admin

Engineer	1	Partial	Builds	Total	N	FRED
Admin	1	Partial	Negotiates (for platinum and super platinum)	Total	1	Contract
Maintenance	M	Total	PerformsMaintenanceSchedule	Partial	1	Maintainer
Zone	N	Total	LocatedIn	Partial	1	Region
Maintainer	1	Partial	Creates	Total	1	ApplicationSession
Standard	1	Partial	ISA	Total	1	Subscription
Gold	1	Partial	ISA	Total	1	Subscription
Platinum	1	Partial	ISA	Total	1	Subscription
SuperPlatinum	1	Partial	ISA	Total	1	Subscription
Platinum	1	Partial	Views	Partial	N	Data
Super Platinum	1	Partial	Owns	Partial	N	Data

Table 3: Document Attributes

Entity Name	Attributes	Description	Domain	Aliases	Composite	Derived	Nulls	Key?	Default Value
FRED	FredID	The unique identifier for every FRED	Integer	RobotID, DroneID	No	No	No	Primary	Auto-increment
	serialNumber	The manufacturers number	Char(20)	serialNo	No	No	No	No	None
	dateCommissioned	The date the FRED started to be of service	DateTime	startDate	No	No	Yes	No	Current date
	Status	The FREDs current status (active, inactive)	Char(20)	Condition	No	No	No	No	'Active'
	lastCommunication	The timestamp of when it last transmitted data	Integer	lastContact lastDataTime	No	No	Yes	No	Current date/time
	batteryLevel	The battery percentage	Decimal(5,2)	currentBattery powerLevel	No	No	No	No	100
Contract	contractID	The unique identifier for every contract	Integer	subscriptionID	No	No	No	Primary	Auto-increment
	startDate	The timestamp of the date the contract started	Date	BeginDate	No	No	No	No	Current date/time
	endDate	The timestamp of the date the contract will/has ended	date	TerminatedDate	No	No	Yes	No	None
	paymentPeriod	The period schedule of the payments	Char(10)	paymentCycle	No	No	No	No	'Monthly'
	discountPercent	The discount that's used for the subscription price	Decimal(5,2)	Discount	No	No	No	No	0.00
	totalValue	The total money value of the contract	Currency	billValue	No	No	No	No	0.00
	isExclusive	Boolean that indicates if any FREDs are exclusive to the contract	Boolean	Exclusive	No	No	No	No	False
Employee	employeeID	The unique identifier of every employee	Integer	workerID	No	No	No	Primary	Auto-increment
	Name	The name of the employee	Char(100)	OrganizationName, CompanyName	Yes (firstName, lastName)	No	No	No	None
	Email	The email address of the employee	Char(255)	WorkerEmail, EmployeeEmail	No	No	No	No	None
	Phone	The phone number of the employee	Integer	WorkerPhone, WorkerPhone	No	No	Yes	No	None
	Position	The employees position	Char(100)	Title, Job, Role	No	No	No	No	None
	Salary	The employees annual salary	Currency	Pay	No	No	Yes	No	None
Salesperson	salesPersonID	The unique identifier of every salesperson	Integer	SalesID, SalesRepID	No	No	No	Primary	Auto-increment
	commissionRate	The percentage of sales that have been earned	Decimal(5,2)	Commission	No	No	No	No	0.00
	maxDiscountPercent	The discount percent that the	Decimal(5,2)	MaxDiscount	No	No	No	No	0.00

Entity Name	Attributes	Description	Domain	Aliases	Composite	Derived	Nulls	Key?	Default Value
		salesperson can provide for clients							
	targetSales	The target number amount of sales they aim for monthly	Currency	Target, SalesTarget	No	No	Yes	No	None
Engineer	engineerID	The unique identifier for each engineer	Integer	TechID	No	No	No	Primary	Auto-increment
	specializesIn	The area that the engineer is an expert in	Char(100)	Expertize, Specialization, Specialty	No	No	Yes	No	None
	Certification	The list of technical certifications	Char(255)	Qualification/s	No	No	Yes	No	None
Executive Admin	adminID	The unique identifier of every executive administrator	Integer	ExecutiveAdminID, AdministratorID	No	No	No	Primary	Auto-increment
	authorizationLevel	Sees the level of authorization	Char(50)	AuthLevel	No	No	No	No	'Standard'
	canChangePrices	The Boolean to see if they have the ability to change prices (for subscriptions)	Boolean	PriceAuthority	No	No	No	No	False
Director	directorID	The unique identifier for each director	Integer	supervisorID	No	No	No	Primary	Auto-increment
	directorName	The name of the director	Char(255)	SupervisorName	Yes (firstName, lastName)	No	No	No	None
	Email	The email of the director	Char(255)	SupervisorEmail	No	No	No	No	None
	Phone	The phone number for the director	Integer	SupervisorPhone	No	No	No	No	None
	position	The position of the director	Char(255)	SupervisorPosition	No	No	No	No	None
Subscriber	subscriberID	The unique identifier for every subscriber	Integer	CustomerID, ClientID	No	No	No	Primary	Auto-increment
	Name	The name of the subscriber (organization)	Char(100)	ClientName, CustomerName, OrganizationName	No	No	No	No	None
	Type	The type of organization subscriber (govt. or private)	Char(50)	OrganizationType, ClientType	No	No	No	No	None
	contactPerson	The name of the contact person for the subscriber	Char(100)	PrimaryContact	Yes (firstName, lastName)	No	No	No	None
	Email	The email address of the subscriber	Char(255)	ContactEmail, ClientEmail	No	No	No	No	None
	Phone	The phone number of the subscriber	Integer	ContactPhone, ClientPhone	No	No	No	No	None
	Address	The physical address of the subscriber	Char(255)	ClientAddress, CustomerAddress, OrganizationAddress, Location	Yes (street, city, state, postalCode, country)	No	No	No	None
	SubscriptionType	Defines what tier they have associated with the contract	Char(10)	TierType, TierPlan, PlanType	No	No	No	No	'Standard'
	accountMade	The timestamp date of when the subscriber registered into the system	Datetime	registerDate	No	No	No	No	Current date

Entity Name	Attributes	Description	Domain	Aliases	Composite	Derived	Nulls	Key?	Default Value
Subscription	subscriptionID	The unique identifier for each subscription type	Integer	PlanID, TierID	No	No	No	Primary	Auto-increment
	Name	The name of the subscription type	Char(50)	PlanName, TierName, SubscriptionName	No	No	No	No	None
	Description	The description of the subscription type	Char(255)	PlanDescription, TierDescription, SubscriptionDescription, SubscriptionTypeDescription	No	No	Yes	No	None
	maxZoneArea	Describes the max zone area in hectares for that type	Decimal(10,2)	MaxArea, ZoneArea	No	No	Yes	No	None
	maxFREDs	Maximum amount of FREDs allowed for the type	Integer	MaxRobots, MaxDrones, MaxRobotAmount, MaxDroneAmount	No	No	Yes	No	None
	maxZone	Describes the max amount of zones for that type	Integer	MaxRegion	No	No	Yes	No	None
	basePrice	The price before discounts	Currency	UsualPrice, StandardPrice, StandardAmount, UsualAmount	No	No	No	No	0.00
	discountPercent	The discount percentage for payments	Numeric(5,2)	DiscountAmount	No	No	No	No	0.00
Standard	StandardID	The unique identifier for every standard subscription	Integer	Tier1ID	No	No	No	Primary	Auto-increment
	AmountOfFRED	The number of FREDs applied (LIMIT 1)	Integer	FREDNumber	No	No	No	No	1 (LIMIT 1)
	AmountOfZones	The number of zones applied in the contract (LIMIT 1)	Integer	ZoneNumber	No	No	No	No	1 (LIMIT 1)
Gold	GoldID	The unique identifier for every gold subscription	Integer	Tier2ID	No	No	No	Primary	Auto-increment
	AmountOfFRED	The number of FREDs applied (LIMIT 3)	Integer	FREDNumber	No	No	No	No	1 (LIMIT 3)
	AmountOfZones	The number of zones applied in the contract (LIMIT 3)	Integer	ZoneNumber	No	No	No	No	1 (LIMIT 3)
Platinum	PlatinumID	The unique identifier for every platinum subscription	Integer	Tier3ID	No	No	No	Primary	Auto-increment
	AmountOfFRED	The number of FREDs applied (UNLIMITED)	Integer	FREDNumber	No	No	No	No	1 (UNLIMITED)
	AmountOfZones	The number of zones applied in the contract (UNLIMITED)	Integer	ZoneNumber	No	No	No	No	1 (UNLIMITED)
Super Platinum	SuperPlatinumID	The unique identifier for every region	Integer	Tier4ID	No	No	No	Primary	Auto-increment
	AmountOfFRED	The number of FREDs applied (UNLIMITED)	Integer	FREDNumber	No	No	No	No	1 (UNLIMITED)
	AmountOfZones	The number of zones applied in the contract (UNLIMITED)	Integer	ZoneNumber	No	No	No	No	1 (UNLIMITED)
Zone	zoneID	The unique identifier for every region	Integer	AreaID	No	No	No	Primary	Auto-increment

Entity Name	Attributes	Description	Domain	Aliases	Composite	Derived	Nulls	Key?	Default Value
	zoneName	The name of the zone	Char(20)	areaName	No	No	No	No	None
	environmentType	The type of environment in the region	Char(50)	SceneryType	No	No	No	No	None
	area	The size of the region in hectares	Decimal(10,2)	ZoneArea, SizeInHectares	No	No	No	No	0.00
	boundary	The boundary coordinates	Char(100)	AreaBoundary, ZoneBoundary	No	No	No	No	None
	country	The country where the zone is	Char(100)	Nation	No	No	No	No	None
Part	partID	The unique identifier for every part for FREDs	Integer	ComponentID	No	No	No	Primary	Auto-increment
	partName	The name of the part	Char(100)	Name, ComponentName	No	No	No	No	None
	Description	The description of the part	Char(255)	PartDescription, ComponentDescription, PartDetails, ComponentDetails	No	No	Yes	No	None
	Category	What type of part it is	Char(50)	PartType, PartCategory	No	No	No	No	None
	Cost	The amount it costs to purchase a part	Currency	PartCost, PartAmount, PartPrice	No	No	No	No	0.00
	stockAmount	How many pieces of stock is available for a part	Integer	StockQuantity, stockCount, InventoryQuantity, InventoryCount	No	No	No	No	0
Supplier	supplierID	The unique identifier for every supplier associated	Integer	VendorID	No	No	No	Primary	Auto-increment
	Name	The name of the supplier company	Char(100)	VendorName, SupplierName	No	No	No	No	None
	contactPerson	The name of the primary contact for the company	Char(100)	VendorContact, SupplierContact	Yes (firstName, lastName)	No	No	No	None
	email	The suppliers email address	Char(255)	VendorEmail, SupplierEmail	No	No	No	No	None
	Phone	The suppliers phone number	Integer	VendorPhone, SupplierPhone	No	No	No	No	None
	Address	The supplier company's physical address	Char(255)	VendorAddress, VendorLocation, SupplierAddress, SupplierLocation	Yes (street, city, state, postalCode, country)	No	No	No	None
Service	serviceID	The unique identifier for every service/ task done	Integer	JobID, TaskID	No	No	No	Primary	Auto-increment
	Description	The description of the service (what task is done)	Char(255)	ServiceDescription, TaskDescription, ServiceDetails, TaskDetails	No	No	Yes	No	None
	category	What type of service it is	Char(50)	ServiceType, ServiceCategory, TaskType, TaskCategory	No	No	No	No	None
Application Entry	applicationEntryID	The unique identifier of every application entry session	Integer	programEntryID, applicationUsageID, applicationSessionID	no	No	No	Primary key	Autoincrement
	usageDescription	The description of what was done during the session	Char(255)	sessionDescription, entryDetails, usageDetails	No	No	Yes	No	None
	LoginTime	The time of login	Datetime	logTime	No	No	Yes	No	CurrentDate
	logoutTime	The time of logout	datetime	exitTime	No	no	Yes	No	None
MaintenanceSchedule	ScheduleID	The unique identifier of every	Integer	timetableID	No	No	No	Primary Key	Auto-increment

Entity Name	Attributes	Description	Domain	Aliases	Composite	Derived	Nulls	Key?	Default Value
RELATINO SHIP		maintenance schedule							
	Requirements	The description of the maintenance required	Char(255)	serviceDescription, ServiceDetails, maintenanceDetails	No	No	No	No	None
	maintenancePeriod	The maintenance interval in days	Integer	ServicePeriod, ServiceInterval, MaintenanceInterval	No	No	No	No	182.5 (6 months)
	estimatedDuration	The estimated time to complete the maintenance in hours	Integer	maintenanceEstimation	No	No	No	No	0.00
Maintenance (Weak)	maintenanceID	The unique identifier for every maintenance service	Integer	RepairID, ServiceID	No	No	No	Composite	Auto-increment
	Date	The date of the service	Datetime	ServiceDate	No	No	No	No	Current Date
	Description	The description of the maintenance service (what was done)	Char(255)	ServiceDescription, ServiceDetails	No	No	No	No	None
	partsUsed (multivalued)	The details on what parts were worked with	Char(255)	componentsUsed, componentsFixed	No	No	Yes	No	None
	Cost	The cost of the maintenance service	Currency	ServiceCost, MaintenanceCost	No	No	No	No	0.00
	nextDate	The date and time of when the next service/maintenance appointment will be	Datetime	NextService, NextMaintenanceDate	No	No	Yes	No	None
Maintainer	maintainerID	The unique identifier for every maintainer	Integer	ServiceProviderID	No	No	No	Primary	Auto-increment
	Name	The name of the maintainer (organization)	Char(100)	OrganizationName	No	No	No	No	None
	contactPerson	The name of the contact person for the maintainer	Char(100)	PrimaryContact	Yes (firstName, lastName)	No	No	No	None
	Email	The email address of the maintainer	Char(255)	ContactEmail, ClientEmail	No	No	No	No	None
	Phone	The phone number of the maintainer	Integer	ServicePhone, OrganizationPhone	No	No	No	No	None
	Address	The physical address of the maintainer	Char(255)	MaintainerAddress, OrganizationAddress, Location	Yes (street, city, state, postalCode, country)	No	No	No	None
	contractStartDate	The start of the maintenance contract	Datetime	serviceStartDate	No	No	No	No	Current Date
	contractEndDate	The end of the maintenance contract	Datetime	serviceEndDate	No	No	Yes	No	None
Data - weak	dataID	The unique identifier for every dataset	Integer	DetailsID, ResultsID	No	No	No	Composite	Auto-increment
	Timestamp	The date and time when the data was collected	Datetime	Data Time	No	No	No	No	Current date/time
	Latitude	The latitude coordinate	Decimal(10,5)	Lat	No	No	No	No	None
	Longitude	Longitude coordinate	Decimal(10,5)	Long	No	No	No	No	None
	Altitude	Altitude written in meters	Decimal(10,5)	Alt	No	No	No	No	None

Entity Name	Attributes	Description	Domain	Aliases	Composite	Derived	Nulls	Key?	Default Value
	Temperature	The temperature of the environment (in Celsius)	Decimal (5,2)	Temp	No	No	No	No	None
	Humidity	The percentage of humidity in the environment	Decimal (5,2)	HumidityLevel	No	No	No	No	None
	lightMeasurement	The measurement of light	Decimal(10,2)	LightLevel	No	No	No	No	None
	organicData	The description for the organic compounds (hydrogen, carbon, oxygen, nitrogen)	Char(255)	AirComposition	No	No	No	No	None
Invoice - weak	invoiceID	The unique identifier for every invoice bill	Integer	BillID	No	No	No	Composite key	Auto-increment
	issueDate	The date the invoice was issued	Datetime	BillDate	No	No	No	No	Current date/time
	dueDate	The date that the payment is due	Datetime	PaymentDue, PayDue	No	No	No	No	Current date + 30 days (month)
	subtotalAmount	The payment amount before tax	Currency	BeforeTaxAmount, PreTaxAmount	No	No	No	No	0.00
	taxAmount	The amount of tax	Currency	GST	No	Yes (subtotalAmount * 0.15)	No	No	0.00
	totalAmount	The total amount for the bill with tax	Currency	BillTotal, InvoiceTotal	No	Yes (subtotalAmount + taxAmount)	No	No	0.00
	status	The status of the payment (if its been paid or if overdue)	Char(20)	PaymentStatus, PayCondition	No	No	No	No	'Unpaid'

Rationale for Data Dictionary:

This dictionary includes definitions for every entity, attribute, relationship and key used in the Extended Entity Relationship Diagram that I had created.

This dictionary focuses on how the data works, what it all means and how its all interconnected with each other.

Each entity was considered based on the business requirements and the processes of the system.

Entity:

Each entity represented an object that is utilized within the system. Each entity is defined with the name, description, aliases (for variety of terminologies), occurrence details and key attributes.

Identifying these helps with clarity throughout the system.

Weak Entities:

Entities like 'data', 'maintenance' etc. are weak entities as they depend on others (e.g., 'data' is dependent on a FRED drone). Utilizing this shows identification rules in the data model.

Attributes:

The attributes describe the data traits for entities. Naming conventions (camelCase) and keys (primary key, foreign key, composite key) have been defined.

The attributes have fields filled to determine if theyre composite, derived and could be nullified. Additional fields include the domains (INT, CHAR, DATETIME) and default values.

Relationships:

All relationships between entities were defined through verb phrases ('FRED *performs* SERVICE'), cardinality (M, M:N, 1:1 etc.) and participation (total/partial).

Speciality/Generalization subtypes have been defined as well – for example, the superclass, 'Employee', has subtypes including 'Salesperson' and 'Admin' – these were showed utilizing a disjoint, which shows that an entity can belong to only one subtype (employee can be either a salesperson or admin, not both.) – as well as this, the U symbol indicates the subtype 'ISA' (is a) subset of the supertype.

This data dictionary utilizes the principles of effective data management through:

1. Data Quality

The names, aliases and descriptions show that the model supports consistent data entry.

2. Scalability

The dictionary allows for easy updates and changes – if a new entity is added in future development, following the structure will mean that its easy to visualize how it can be added into the system.

3. Support for normalization

The dictionary is useful as it identifies how the system could work to promote data integrity and overcomplication in the interface and database.

4. Clarity

By being able to document what each entity/attribute/relationship is and how its used, it ensures that designing the system is simple and that the stakeholders can understand how it'll work. This reduces confusing when the database system is created.

Assumed Business Rules (with reasoning):

1. A region contains one or more zones

Regions are bigger areas that can be subdivided into different zones. The reason for this is that it is easier to manage particular areas, which avoids redundant environment information and entries

2. Directors hire admins, admins hire salespeople and engineers

There is a set hierarchy for employing workers. The reason for this is to have business structure with set controls – this is beneficial for RBAC (role based access control)/

3. An invoice is created for one contract

A contract will eventually have a bill for the subscriber and the invoice is generated based on what had been included in the contract. It enables financial tracking and integration with the accounting systems.

4. Maintainers perform maintenance based on a schedule

Maintainers will be able to follow a schedule, which supports timely service and proper organization.

5. FRED performs services and collects/generates data

FREDs are responsible to perform services such as tree trimming, planting, track clearing etc.. Through doing the services, they capture data to create reports – this ensures automation in data generation.

6. Contracts can operate within one or more zones (dependent on subscription)

Services and data are generated based on the zones that are set – based on the subscription that the contract has set, one or more zones can be monitored and serviced by FREDs.

7. Contracts are categorized by subscription type

Every contract should have one subscription type assigned (standard, gold, platinum or super platinum). The categorization is necessary to showcase the additional features that might apply and to display any service level negotiations.

8. A salesperson can place many contracts, but each contract is placed by one person

One salesperson is responsible for closing each contract – this simplifies accountability. It helps prevent additional employees being set to the same contract, which isn't necessary. One salesperson can place many contracts for different clients, however.

9. An admin can negotiate many contract, but each contract is negotiated by one admin

The admin finalizes contracts that had been placed by salespeople. Having the differentiation between what the admin does and what the salesperson does is necessary as it shows the hierarchy levels of the roles – the salesperson markets and initiates and the admin confirms. The contract cannot be finalized until the admin overlooks it.

10. Subscription types define the contract pricing, service levels etc.

Subscription tiers determine what the contract can have. This helps with service automation

11. The maintenance application entry records maintainer usage and is used to store maintenance records

The maintainers use an app to input the maintenance details and check the schedules – the application entry entity would record when the last session was for every maintainer and when they were active. This would facilitate monitoring the usage and accountability of a particular maintainer.