INFO 364 – Term Project

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1. Conceptual Model

Sources of Entity & Relationship Types:

Business Rule		Entity Types	Relationship Types
ID	**Description**		
1.	A *Procurement Transaction* has a unique identifier (*TP_ID*), transaction amount (*TP_Amount*), vehicle mileage at the time of the event (*TP_Mileage*), and the event date (*TP_Date*).	Procurement Transaction	…
1.a.	A single *Vehicle* is purchased in a given *Procurement Transaction* but it is possible that a given *Vehicle* could be purchased in different *Procurement Transaction*s.	Vehicle, Procurement Transaction	Purchases {Vehicle(1), Procurement Transaction(M)}
1.b.	A single *Supplier* is involved in a given *Procurement Transaction* but it is possible that a given *Supplier* could be involved in several *Procurement Transaction*s.	Supplier, Procurement Transaction	Involved {Supplier(1), Procurement Transaction(M)}
1.c.	Each *Procurement Transaction* occurs at a specific *Branch*; multiple *Procurement Transactions* may occur at a given *Branch*.	Procurement Transaction, Branch	Occurs {Procurement Transaction(M), Branch(1)}
1.d.	A single *Transaction Agent* processes each *Procurement Transaction*; several *Procurement Transactions* may be processed by a given *Transaction Agent* but some *Transaction Agents* may have never processed any *Procurement Transaction*.	Transaction Agent, Procurement Transaction	Processed by PT {Transaction Agent(1), Procurement Transaction(M)}
2.	A *Supplier* could be: a *Manufacturer*, a *Private Seller*, or *Customer* involved in a trade-in.	Supplier, Manufacturer, Private Seller, Customer	
3.	Each *Manufacturer* has an identifier (FR_ID), name (FR_Name), years-in-business (FR_YRSBUS) & *location (FR_Street, City, State, ZipCode*).	Manufacturer	
4.	Each *Private Seller* has an identifier (PC_ID), name (PC_Name), reliability score (PC_RSCR) & *location (PC_Street, City, State, ZipCode*).	Private Seller	
5.	A *Customer* is a *Person* or an *Organization*. Attributes recorded for all *Customers* include *CID, Name, Address, Balance*; additional attributes recorded for *Person Customers include DOB, SSN*.	Customer, Person, Organization	
6.	A *Sales Transaction* has a unique identifier (*TS_ID*), transaction amount (*TS_Amount*), vehicle mileage at the time of the event (*TS_Mileage*), and the event date (*TS_Date*).	Sales Transaction	
6.a.	For each *Sales Transaction* event there is single *Vehicle* that is sold, but each *Vehicle* could be sold in multiple *Sales Transaction* events.	Sales Transaction, Vehicle	Sold in {Sales Transaction(M), Vehicle(1)}
6.b.	Each *Sales Transaction* event is processed by a single *Transaction Agent*, each *Transaction Agent* could process multiple *Sales Transaction* events.	Sales Transaction, Transaction Agent	Processes ST {Sales Transactions(M), Transaction Agent(1)}
6.c.	For each *Sales Transaction* event there is a single *Customer*, and each *Customer* could be the buyer in different *Sales Transaction* events.	Sales Transaction, Customer	Participates in {Sales Transaction(M), Customer(1)}
6.d.	For each *Sales Transaction* event occurs at single *Branch*, and multiple *Sales Transactions* could occur at a given *Branch*.	Sales Transaction, Branch	Has {Sales Transaction(M), Branch(1)}
7.	For each *Vehicle* there is a specific *Vehicle Model* (e.g. Ford Taurus), and a single current owner, who is considered to be the *Customer*. Attributes recorded for each *Vehicle* include identifier (*VIN*), *Year, Colors, current License Number, State*. Attributes recorded for each *Vehicle Model* include its identifier (*VMID*), *Name, Start Year, End_Year, Miles per Gallon*.	Vehicle, Vehicle Model, Customer	Stated {Vehicle(M), Vehicle Model(1)} Owns {Customer(1), Vehicle(M)}
8.	Some *Employees* are classified as *Managers*, *Transaction Agents* or *Service Technicians*, but there are employees who are neither *Managers nor Transaction Agents* nor *Service Technicians*. In addition to the regular attributes of all *Employees* (*e.g. EID, Name, DOB, Degrees, address (i.e. E_Street, City, State, Zipcode), Marital Status, Hire Date, SSN*), the *Commission Rate* is recorded for each *Transaction Agent*; the *Hourly Labor Charge Rate* & *Level* (i.e. *Senior, Associate*) is recorded for each *Service Technician*; and the *Promotion Date* is recorded for each *Manager*.	Employee, Manager, Transaction Agent, Service Technician	

9.	Each *Branch* has a unique identifier (*BR_ID*), name (*BR_Name*), phone number (*BR_Phone_Number*) & *location (BR_Street, City, State, ZipCode*).	Branch	
9.a.	Each *Employee* is assigned to a specific *Branch*; the start date (*EA_Start_Date*) & end date (*EA_End_Date*) of this assignment are recorded, where the end date can be null.	Employee, Branch	Assigned {Employee(M), Branch(1)}
9.b	Each *Branch* is managed by a single *Manager*, with the corresponding start date (*BM_Start_Date*) & end date (*BM_End_Date*) being recorded, where the end date can be null.	Branch, Manager	Manages {Branch(1), Manager(1)}
10.	Each *Maintenance Service Order* has a unique identifier (*MO_ID*), current vehicle mileage (*MO_Mileage*), & event date (*MO_Start_Date*).	Maintenance Service Order	
10.a.	Each *Maintenance Service Order* is executed at a specific *Branch*; several *Maintenance Service Orders* may be executed at a given *Branch*.	Maintenance Service Order, Branch	Executes {Maintenance Service Order(M), Branch(1)}
10.b.	Each *Maintenance Service Order* is for a single *Customer*; each *Customer* could be involved in multiple *Maintenance Service Orders*.	Maintenance Service Order, Customer	Pertains {Maintenance Service Order(M), Customer(1)}
10.c.	Each *Maintenance Service Order* is sold by a single *Transaction Agent*, and each *Transaction Agent* could sell multiple *Maintenance Service Orders*.	Maintenance Service Order, Transaction Agent	Dispenses {Maintenance Service Order(M), Transclnaction Agent(1)}
10.d.	Each *Maintenance Service Order* involves a single *Vehicle*, and each *Vehicle* could be involved in multiple *Maintenance Service Orders*.	Maintenance Service Order, Vehicle	Identifies {Maintenance Service Order(M), Vehicle(1)}
10.e.	Each *Maintenance Service Order* consists of one or more *Maintenance Service Item*s.	Maintenance Service Order, Maintenance Service Item	Consists {Maintenance Service Order(1), Maintenance Service Item(M)}
11.	Each *Maintenance Service Item* has the following attributes: local identifier (*MSI_ID*), *Actual Start Date*, *Actual End Date*, *Charged Labor Cost* & *Charged Labor Hours* are also recorded.	Maintenance Service Item	
11.a	For a given *Maintenance Service Item*, a single *Service Technician* is assigned; a given *Service Technician* may be assigned to multiple *Maintenance Service Items*.	Maintenance Service Item, Service Technician	Correlates {Maintenance Service Item(M), Service Technician(1)}
12.	For each *Vehicle Part*, there is an identifier (*Part_ID*), description (*PR_Description*) and cost (*PR_COST*).	Vehicle Part	
13.	Each *Maintenance Problem* (e.g. engine tune-up, tire rotation, oil change) has an identifier (*MP_ID*), description (*MP_Description*), a *Standard Minimum Labor Cost*, & *Standard Minimum Labor Hours*.	Maintenance Problem	
13.a.	Each *Maintenance Service Item* corresponds to a single *Maintenance Problem*; each *Maintenance Problem* may corresponds to a multiple *Maintenance Service Item*s.	Maintenance Service Item, Maintenance Problem	Corresponds {Maintenance Service Item(M), Maintenance Problem(1)}
13.b.	Each *Service Technician* is qualified to service one or more *Maintenance Problem*s. Multiple *Service Technicians* may be qualified to service a given *Maintenance Problem*. The corresponding *Last Qualified Date* is recorded.	Service Technician, Maintenance Problem	Qualifies {Service Technician(M), Maintenance Problem(M)}
13.c.	A set of one or more *Vehicle Part*s are required to fix a given *Maintenance Problem*; a given *Vehicle Part* may be required in order to fix one or more *Maintenance Problems*.	Vehicle Part, Maintenance Problem	Requires {Vehicle Part(M), Maintenance Problem(M)}

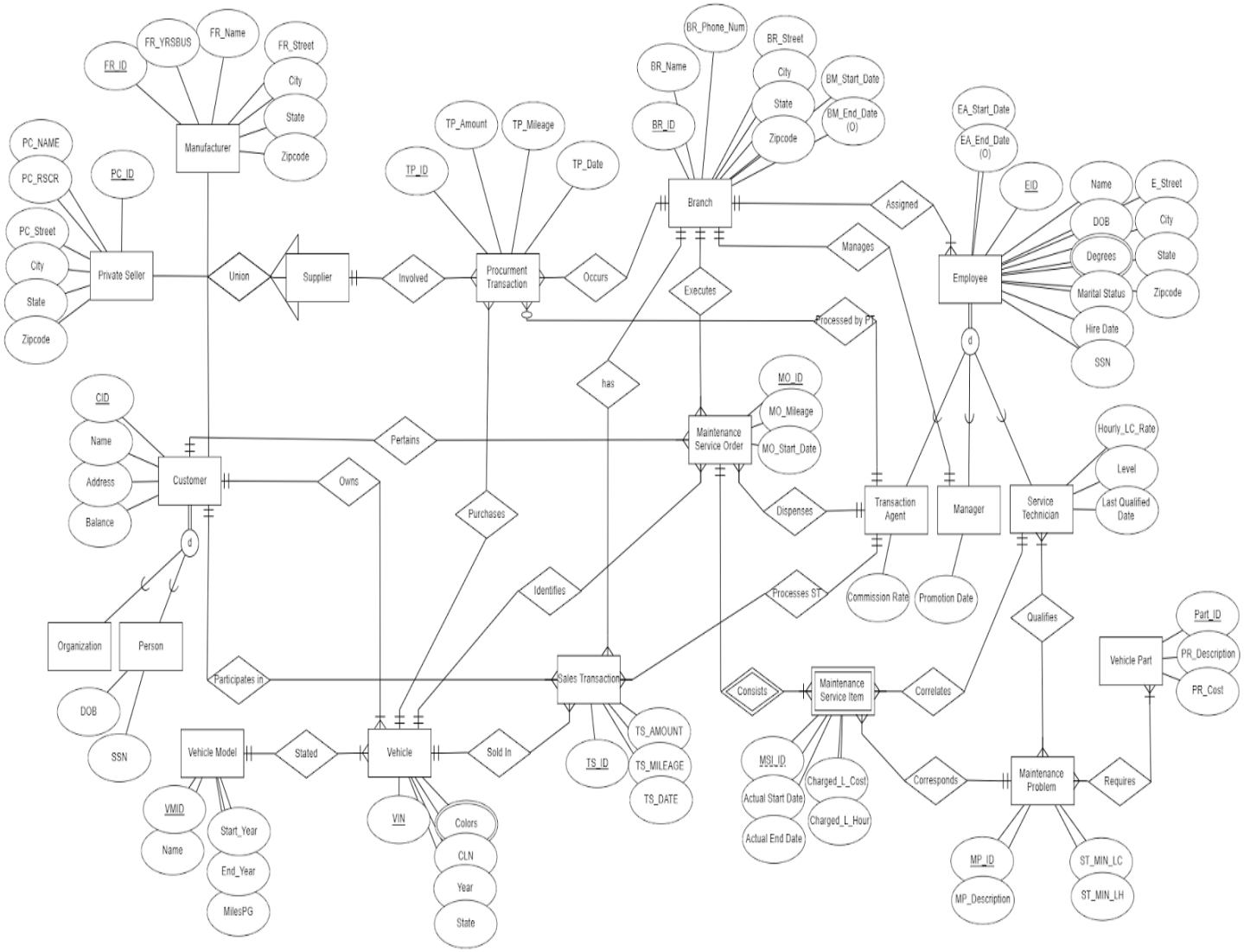
Entity/Relationship Classification:

Entities	Name of Entity	Classification	List of Attributes	Identifier
	Procurement Transaction	….. Regular	TP_ID, TP_Date, TP_Amount, TP_Mileage,	TP_ID
	Branch	Regular	BR_ID, BR_Name, BR_Phone_Number, BM_Start_Date, BM_End_Date, BR_Street, City, State, Zipcode,	BR_ID
	Manufacturer	Supertype	FR_ID, FR_YRSBUS, FR_Name, FR_Street, City, State, Zipcode	FR_ID
	Private Seller	Supertype	PC_ID, PC_Name, PC_RSCR, PC_Street, City, State, Zipcode	PC_ID
	Customer	Supertype	CID, Name, Address, Balance	CID
	Organization	Subtype	CID	CID
	Person	Subtype	CID, DOB, SSN	CID
	Vehicle	Regular	VIN, Colors, CLN, Year, State	VIN
	Vehicle Model	Regular	VMID, Name, Start_Year, End_Year, MilesPG	VMID
	Sales Transaction	Regular	TS_ID, TS_Amount, TS_Mileage, TS_Date	TS_ID
	Maintenance Service Order	Regular	MO_ID, MO_Mileage, MO_Start_Date	MO_ID
	Maintenance Service Item	Weak	MO_ID, MSI_ID, Actual Start Date, Actual End Date, Charged_L_Cost, Charged_L_Hour	MO_ID, MSI_ID
	Maintenance Problem	Regular	MP_ID, MP_Description, ST_MIN_LC, ST_MIN_LH	MP_ID
	Vehicle Part	Regular	Part_ID, PR_Description, PR_Cost	Part_ID
	Employee	Supertype	EID, Name, DOB, Degrees, Marital Status, Hire Date, SSN, EA_Start_Date, EA_End_Date, E_Street, City, State, Zipcode	EID
	Transaction Agent	Subtype	EID, Commission Rate	EID
	Manager	Subtype	EID, Promotion Date	EID
	Service Technician	Subtype	EID, Hourly_LC_Rate, Level, Last Qualified Date	EID

Categories	Name of Category	Names of Participating Entities	Identifier
	Supplier	Manufacturer, Private Seller, Customer	SUPP_ID

Relationships	Name of Relationship	Classification	Names of Participating Entities/Categories	List of Non-Identifier Attributes
	Occurs	… 1:M	Branch : Procurement Transaction	
	Has	1:M	Branch : Sales Transaction	
	Executes	1:M	Branch : Maintenance Service Order	
	Manages	1:1	Manager : Branch	
	Assigned	1:M	Branch : Employee	
	Processed by PT	1:M	Transaction Agent : Procurement Transaction	
	Purchases	1:M	Vehicle : Procurement Transaction	
	Involved	1:M	Supplier : Procurement Transaction	
	Pertains	1:M	Customer : Maintenance Service Order	
	Owns	1:M	Customer : Vehicle	
	Participates in	1:M	Customer : Sales Transaction	
	Stated	1:M	Vehicle Model : Vehicle	
	Identifies	1:M	Vehicle : Maintenance Service Order	
	Sold in	1:M	Vehicle : Sales Transaction	
	Processes ST	1:M	Transaction Agent : Sales Transaction	
	Consists	1:M	Maintenance Service Order : Maintenance Service Item	
	Dispenses	1:M	Transaction Agent : Maintenance Service Order	
	Correlates	1:M	Service Technician : Maintenance Service Item	
	Corresponds	1:M	Maintenance Problem : Maintenance Service Item	
	Qualifies	M:M	Service Technician : Maintenance Problem	
	Requires	M:M	Vehicle Part : Maintenance Problem	

Visual Representation of Entity-Relationship Model (ERM):



Justification/Assumptions made:

1. Every Procurement Transaction must have a Supplier, Vehicle, Transaction Agent, and take place at a specific Branch; the relationship to those entities would be mandatory.
2. Every Sales Transaction must have a Customer, Vehicle, Transaction Agent, and take place at a specific Branch; the relationship to those entities would be mandatory.
3. Every Branch must have a Manager, Every Manager must be assigned to a Branch; both would be mandatory.
4. Every Branch must be assigned Employees, Employees must be assigned to a specific Branch; both would be mandatory.
5. Every Maintenance Service Order involves a Vehicle, Customer, specific Branch, one or more Maintenance Service Items, and a Transaction Agent; the relationship to those entities would be mandatory.
6. A Maintenance Service Item can not exist without a Maintenance Service Order, mandatory, and each Maintenance Service Item is assigned to a Service Technician and Maintenance Problem, the relationship to those entities would be mandatory.
7. Each Maintenance Problem must have one or more Service Technicians and one or more Vehicle Parts, the relationship to those entities would be mandatory.

Entity Specification:

Procurement Transaction : the procurement of a transaction that is about to place, notification for all parties involved.

Attribute	Description	Datatype	Size	Decimal Positions	Domain
TP_ID	Transaction ID	Numeric	8	0	> 0
TP_Date	Date of Transaction	Date			
TP_Amount	Amount Spent in Transaction	Numeric	8	2	>= 0
TP_Mileage	Mileage on Car	Numeric	6	0	>= 0

Branch : The main branch where the associating entity and its relationship is taking place.

Attribute	Description	Datatype	Size	Decimal Positions	Domain
BR_ID	ID Branch Number	Numeric	8	0	>0
BR_Name	Branch Name	Character	1-30		
BR_Phone_Number	Branch Phone Number	Numeric	10	0	
BM_Start_Date	Branch Manager Start Date	Date			
BM_End_Date	Branch Manager End Date	Date			
BR_Street	Branch street address	Character	1-25		
City	Branch city address	Character	1-15		
State	Branch State address	Character	1-15		
Zipcode	Branch Zipcode	Numeric	5	0	>0

Manufacturer : The manufacturer of a new car involved in a transaction.

Attribute	Description	Datatype	Size	Decimal Positions	Domain
FR_ID	Manufacturer ID	Numeric	8	0	>0
FR_YRSBUS	Manufacturer years in busn.	Numeric	2	0	>0
FR_Name	Manufacturer Name	Character	1-30		
FR_Street	Manufacturer Street address	Character	1-25		
City	Manufacturer city address	Character	1-15		
State	Manufacturer State address	Character	1-15		
Zipcode	Manufacturer Zipcode	Numeric	5	0	>0

Private Seller : A possible supplier involved in a Trade-In.

Attribute	Description	Datatype	Size	Decimal Positions	Domain
PC_ID	Private Seller ID	Numeric	8	0	>0
PC_Name	Private Seller Name	Character	1-30		
PC_RSCR	Private Seller Reliability Score	Numeric	2	0	between 0 and 10
PC_Street	Private Seller Street address	Character	1-25		
City	Private Seller city address	Character	1-15		
State	Private Seller State address	Character	1-15		
Zipcode	Private Seller Zipcode	Numeric	5	0	>0

Customer : A Person/Org. and possible supplier involved in a Trade-In.

Attribute	Description	Datatype	Size	Decimal Positions	Domain
CID	Customer ID	Numeric	8	0	>0
Name	Customer Name	Character	1-30		
Address	Customer Address	Character	1-30		
Balance	Customer Balance	Numeric	6	2	between 0 and 999,999

Organization : An Organization-type customer possibly supplying a Trade-In.

Attribute	Description	Datatype	Size	Decimal Positions	Domain
CID	Customer ID	Numeric	8	0	>0

Person : A Person-Type customer possibly supplying a Trade-In.

Attribute	Description	Datatype	Size	Decimal Positions	Domain
CID	Customer ID	Numeric	8	0	>0
DOB	Customer Date of Birth	Date			

SSN	Customer Social Security No.	Numeric	9	0	>0

Vehicle : Vehicles involved in transactions.

Attribute	Description	Datatype	Size	Decimal Positions	Domain
VIN	Vehicle Vin No.	Numeric	17	0	>0
Colors	Vehicle color Description	Character	1-15		
CLN	Current License Plat No.	Character	7		
Year	Vehicle Year	Numeric	4	0	>0
State	Vehicle State	Character	1-15		

Vehicle Model : Vehicle Model of Vehicle involved in a transaction.

Attribute	Description	Datatype	Size	Decimal Positions	Domain
VMID	Vehicle Model ID	Numeric	8	0	>0
Name	Vehicle Model Name	Character	1-15		
Start_Year	Vehicle Model Start Year	Date			
End_Year	Vehicle Model End Year	Date			
MilesPG	Vehicle Model Miles Per Gallon	Numeric	2	0	>0

Sales Transaction : An event in which a single vehicle is sold.

Attribute	Description	Datatype	Size	Decimal Positions	Domain
TS_ID	Sales Transaction ID	Numeric	8	0	>0
TS_AMOUNT	Sales Transaction Amount	Numeric	7	2	between 0 and 1,000,000
TS_MILEAGE	Sales Transaction Vehicle Mileage	Numeric	6	0	>=0
TS_DATE	Sales Transaction Date	Date			

Maintenance Service Order : Maintenance service to be performed on a vehicle.

Attribute	Description	Datatype	Size	Decimal Positions	Domain
MO_ID	Maintenance Service Order ID	Numeric	8	0	>0
MO_Mileage	Maintenance Service Order Vehicle Mileage	Numeric	6	0	>=0
MO_Start_Date	Maintenance Service Order Start Date	Date			

Maintenance Service Item : Items involved in Maintenance Orders.

Attribute	Description	Datatype	Size	Decimal Positions	Domain
MO_ID	Maintenance Service Order ID	Numeric	8	0	>0
MSI_ID	Maintenance Service Item ID	Numeric	8	0	>0
Actual_Start_Date	Maintenance Service Item Start Date	Date			
Actual_End_Date	Maintenance Service Item End Date	Date			
Charged_L_Cost	Charged Labor Cost	Numeric	5	2	>0
Charged_L_Hour	Charged Labor Hours	Numeric	3	1	>0

Maintenance Problem : Issue with vehicle involved in Maintenance Service.

Attribute	Description	Datatype	Size	Decimal Positions	Domain
MP_ID	Maintenance Problem ID	Numeric	8	0	>0
MP_Description	Maintenance Problem Desc.	Char.	1-100		
ST_MIN_LC	Standard Min. Labor Costs	Numeric	4	2	>0
ST_MIN_LH	Standard Min. Labor Hours	Numeric	2	0	>0

Vehicle Part : Part required to fix a vehicle involved in Maintenance Service.

Attribute	Description	Datatype	Size	Decimal Positions	Domain
Part_ID	Vehicle Part ID	Numeric	8	0	>0
PR_Description	Vehicle Part Description	Character	1-50		
PR_Cost	Vehicle Part Cost	Numeric	4	2	>0

Employee : Employee working at a certain Branch.

Attribute	Description	Datatype	Size	Decimal Positions	Domain
EID	Employee ID	Numeric	8	0	>0
EA_Start_Date	Employee Start Date	Date			
EA_End_Date	Employee End Date	Date			
Name	Employee Name	Character	1-30		
DOB	Employee Date of Birth	Date			
Degrees	Degrees obtained by Employee	Numeric	1	0	>=0
Marital Status	Employee Marital Status	Character	1-7		
Hire Date	Employee Hire Date	Date			
SSN	Employee Social Security No.	Numeric	9	0	>0
E_Street	Employee Street Address	Character	1-25		
City	Employee City Address	Character	1-15		
State	Employee State Address	Character	1-15		
Zipcode	Employee Zipcode	Numeric	1-5	0	>0

Transaction Agent : A specific Employee working at a branch responsible for facilitating transactions.

Attribute	Description	Datatype	Size	Decimal Positions	Domain
EID	Employee ID	Numeric	8	0	>0
Commission Rate	Transaction Agent Commission Rate	Numeric	2	2	>0

Manager : A specific Employee working at a branch responsible for overseeing business operations.

Attribute	Description	Datatype	Size	Decimal Positions	Domain
EID	Employee ID	Numeric	8	0	>0
Promotion Date	Date Employee was promoted to manager	Date			

Service Technician : A specific Employee working at a branch responsible for servicing vehicles.

Attribute	Description	Datatype	Size	Decimal Positions	Domain
EID	Employee ID	Numeric	8	0	>0
Hourly_LC_Rate	Hourly Service Techn. Rate	Numeric	2	2	>0
Level	Senior, Associate, etc.	Character	1-9		
Last Qualified Date	Date of Last Qualified Maintenance Service employee was involved in	Date			

Relationship Specification:

Occurs : A procurement transaction has to occur at a branch.

Participating Entities	Connectivity (1:M, M:M)	If M:M, List Attributes of Relationship□Only use next 5 columns for M:M Relationships	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain
Branch: Procurement Transaction	1:M						

Has : A branch has sales transactions

Participating Entities	Connectivity (1:M, M:M)	If M:M, List Attributes of Relationship□Only use next 5 columns for M:M Relationships	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain
Branch: Sales transactions	1:M						

Executes : A branch executes Maintenance Service Orders

Participating Entities	Connectivity (1:M, M:M)	If M:M, List Attributes of Relationship□Only use next 5 columns for M:M Relationships	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain
Branch: Maintenance Service Order	1:M						

Manages : A manager manages a branch

Participating Entities	Connectivity (1:M, M:M)	If M:M, List Attributes of Relationship□Only use next 5 columns for M:M Relationships	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain
Manager: Branch	1:1						

Assigned : A Branch is assigned employees

Participating Entities	Connectivity (1:M, M:M)	If M:M, List Attributes of Relationship□Only use next 5 columns for M:M Relationships	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain
Branch: Employee	1:M						

Processed by PT : A procurement transaction is processed by a transaction agent

Participating Entities	Connectivity (1:M, M:M)	If M:M, List Attributes of Relationship□Only use next 5 columns for M:M Relationships	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain
Transaction Agent: Procurement Transaction	1:M						

Purchases : A procurement transaction purchases a vehicle

Participating Entities	Connectivity (1:M, M:M)	If M:M, List Attributes of Relationship□Only use next 5 columns for M:M Relationships	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain
Vehicle: Procurement Transaction	1:M						

Involved : Supplier is involved in procurement transactions

Participating Entities	Connectivity (1:M, M:M)	If M:M, List Attributes of Relationship□Only use next 5 columns for M:M Relationships	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain

Supplier: Procurement Transaction	1:M						

Pertains : A Maintenance Service order pertains a customer

Participating Entities	Connectivity (1:M, M:M)	If M:M, List Attributes of Relationship□Only use next 5 columns for M:M Relationships	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain
Customer: Maintenance Service Order	1:M						

Owns : A customer owns a vehicle

Participating Entities	Connectivity (1:M, M:M)	If M:M, List Attributes of Relationship□Only use next 5 columns for M:M Relationships	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain
Customer: Vehicle	1:M						

Participates in: A customer participates in a sales transaction

Participating Entities	Connectivity (1:M, M:M)	If M:M, List Attributes of Relationship□Only use next 5 columns for M:M Relationships	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain
Customer: Sales transaction	1:M						

Stated : Vehicles have stated vehicle models

Participating Entities	Connectivity (1:M, M:M)	If M:M, List Attributes of Relationship□Only use next 5 columns for M:M Relationships	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain
Vehicle Model: vehicle	1:M						

Identifies : Maintenance Service order identifies vehicle

Participating Entities	Connectivity (1:M, M:M)	If M:M, List Attributes of Relationship□Only use next 5 columns for M:M Relationships	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain
Vehicle: Maintenance Service Order	1:M						

Sold In : Vehicle is sold in a sales transaction

Participating Entities	Connectivity (1:M, M:M)	If M:M, List Attributes of Relationship□Only use next 5 columns for M:M Relationships	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain
Vehicle: Sales transaction	1:M						

Processes ST : A transaction agent processes a sales transaction

Participating Entities	Connectivity (1:M, M:M)	If M:M, List Attributes of Relationship□Only use next 5 columns for M:M Relationships	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain
Transaction agent: Sales transaction	1:M						

Consists : Maintenance Service order consists of maintenance service item

Participating Entities	Connectivity (1:M, M:M)	Constraint	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain
Maintenance Service Order: Maintenance Service Item	1:M	Maintenance Service Items can NOT exist if there is no Maintenance Service Order.					

Dispenses : A Transaction agent dispenses a maintenance service order

Participating Entities	Connectivity (1:M, M:M)	If M:M, List Attributes of Relationship□Only use next 5 columns for M:M Relationships	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain
Transaction Agent: Maintenance Service Order	1:M						

Correlates : A Service technician correlates maintenance service items

Participating Entities	Connectivity (1:M, M:M)	If M:M, List Attributes of Relationship□Only use next 5 columns for M:M Relationships	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain
Service Technician : Maintenance Service Item	1:M						

Corresponds : A maintenance problem corresponds to a maintenance service item

Participating Entities	Connectivity (1:M, M:M)	If M:M, List Attributes of Relationship□Only use next 5 columns for M:M Relationships	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain
Maintenance Problem : Maintenance Service Item	1:M						

Qualifies : A service technician qualifies maintenance problems

Participating Entities	Connectivity (1:M, M:M)	If M:M, List Attributes of Relationship□Only use next 5 columns for M:M Relationships	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain
Service Technician : Maintenance Problem	M:M	EID MP_ID	Employee ID Maintenance Problem ID	Numeric Numeric	8 8	0 0	>0 >0

Requires : A vehicle part requires a maintenance problem

Participating Entities	Connectivity (1:M, M:M)	If M:M, List Attributes of Relationship□Only use next 5 columns for M:M Relationships	Name & Txt Desc	Data Type	Size	Decimal Positions	Domain
Vehicle Part : Maintenance Problem	M:M	Part_ID MP_ID	Vehicle Part ID Maintenance Problem ID	Numeric Numeric	8 8	0 0	>0 >0

Conceptual Modeling: Individual Team Member Report	
Name of Team Member:	Jason Rogers, Adrian Brown, Christopher Lane

Detailed Description of what you did

Our team worked well together. Every member displayed excellent communication skills, a highly focused resolve for completion of the work, and a willingness to broaden our understanding and scope of the project by including everyone's input.

Description of what you learned:

Our team gained a better understanding of ERD relational models and how to normalize relations to 3NF.

2. Transformation of ERD to Relational Data Model (RDM)

Description of the Initial Relational Data Model that corresponds to the ERD:

	Name	PK	Non-PK,FK Attributes	FK(s)
REGULAR ENTITIES	Procurement Transaction	TP_ID	TP_Amount, TP_Mileage, TP_Date	BR_ID, VIN, EID, SUPP_ID
	Branch	BR_ID	BR_Name, BR_Phone_Number, BM_Start_Date, BM_End_Date, BR_Street, City, State, Zipcode	EID
	Vehicle	VIN	Colors, CLN, Year, State	VMID, CID
	Vehicle Model	VMID	Name, Start_Year, End_Year, MilesPG	
	Sales Transaction	TS_ID	TS_Amount, TS_Mileage, TS_Date	BR_ID, CID, VIN, EID
	Maintenance Service Order	MO_ID	MO_Mileage, MO_Start_Date	BR_ID, CID, VIN, MSI_ID, EID
	Maintenance Problem	MP_ID	MP_Description, ST_MIN_LC, ST_MIN_LH	
	Vegicle Part	PART_ID	PR_Description, PR_Cost	
WEAK ENTITIES	Maintenance Service Item	MO_ID, MSI_ID	Actual Start Date, Actual End Date, Charged_L_Cost, Charged_L_Hour	MO_ID, EID, MP_ID
SUPERTYPE ENTITIES	Manufacturer	FR_ID	FR_YRSBUS, FR_Name, FR_Street, City, State, Zipcode	SUPP_ID
	Private Seller	PC_ID	PC_Name, PC_RSCR, PC_Street, City, State, Zipcode	SUPP_ID
	Customer	CID	Name, Address, Balance	SUPP_ID
	Employee	EID	Name, DOB, Degrees, Marital Status, Hire Date, SSN, EA_Start_Date, EA_End_Date, E_Street, City, State, Zipcode	BR_ID
SUBTYPE ENTITIES	Organization	CID		CID
	Person	CID	DOB, SSN	CID
	Transaction Agent	EID	Commission Rate	CID
	Manager	EID	Promotion Date	EID
	Service Technician	EID	Hourly_LC_Rate, Level, Last Qulified Date	EID
CATEGORIES	Supplier	SUPP_ID	SUPP_TYPE	
M:M RELATIONSHIPS	Qualifies	EID, MP_ID		EID, MP_ID
	Requires	MP_ID, Part_ID		MP_ID, Part_ID

Functional Dependencies & Justification:

Procurement Transaction (
{TP_ID, TP_Date, TP_Amount, TP_Mileage};
{TP_ID→TP_Date, TP_Amount, TP_Mileage})
DESC : The relation is in 3NF, 2NF, and 1NF as the relation has no multivalued attributes with a single attribute as its primary key with no transitive dependencies.

Branch (
{BR_ID, BR_Name, BR_Phone_Number, BM_Start_Date, BM_End_Date, BR_Street, City, State, Zipcode};
{BR_ID→BR_Name, BR_Phone_Number, BM_Start_Date, BM_End_Date, BR_Street, Zipcode;
Zipcode→City, State})
DESC: This relation is not in 3NF as it has a transitive dependency. But it is 1NF and 2NF as the PK consists of a single attribute.

Manufacturer (
{FR_ID, FR_YRSBUS, FR_Name, FR_Street, City, State, Zipcode};
{FR_ID→FR_YRSBUS, FR_Name, FR_Street, Zipcode;
Zipcode→City, State})
DESC: This relation is not in 3NF as it has a transitive dependency. But it is 1NF and 2NF as the PK consists of a single attribute.

Private Seller (
{PC_ID, PC_Name, PC_RSCR, PC_Street, City, State, Zipcode};
{PC_ID→PC_Name, PC_RSCR, PC_Street, Zipcode;
Zipcode→City, State})
DESC: This relation is not in 3NF as it has a transitive dependency. But it is 1NF and 2NF as the PK consists of a single attribute.

Customer (
{CID, Name, Address, Balance};
{CID→Name, Address, Balance})
DESC : The relation is in 3NF, 2NF, and 1NF as the relation has no multivalued attributes with a single attribute as its primary key with no transitive dependencies.

Organization (
{CID}
DESC : The relation is in 3NF, 2NF, and 1NF as the relation has no multivalued attributes with a single attribute as its primary key with no transitive dependencies.

Person (
{CID, DOB, SSN};
{CID→DOB, SSN}
DESC : The relation is in 3NF, 2NF, and 1NF as the relation has no multivalued attributes with a single attribute as its primary key with no transitive dependencies.

Vehicle (
{VIN, CLN, Year, State, Colors};
{VIN→CLN, Year, State, Colors;
VIN→Colors})
DESC: This relation is not in 3NF as it has a multivalued attribute. It is also not in 1NF or 2NF.

Vehicle Model (
{VMID, Name, Start_Year, End_Year, MilesPG};
{VMID→Name, Start_Year, End_Year, MilesPG})
DESC : The relation is in 3NF, 2NF, and 1NF as the relation has no multivalued attributes with a single attribute as its primary key with no transitive dependencies.

Sales Transaction (

{TS_ID, TS_Amount, TS_Mileage, TS_Date};
{TS_ID→TS_Amount, TS_Mileage, TS_Date})
DESC : The relation is in 3NF, 2NF, and 1NF as the relation has no multivalued attributes with a single attribute as its primary key with no transitive dependencies.

Maintenance Service Order (
{MO_ID, MO_Mileage, MO_Start_Date};
{MO_ID→MO_Mileage, MO_Start_Date})
DESC : The relation is in 3NF, 2NF, and 1NF as the relation has no multivalued attributes with a single attribute as its primary key with no transitive dependencies.

Maintenance Service Item (
{MSI_ID, MO_ID, Actual Start Date, Actual End Date, Charged _L_Cost, Charged_L_Hour};
{MSI_ID→MO_ID, Actual Start Date, Actual End Date, Charged_L_Cost, Charged_L_Hour})
DESC : The relation is in 3NF, 2NF, and 1NF as the relation has no multivalued attributes with a single attribute as its primary key with no transitive dependencies.

Maintenance Problem (
{MP_ID, MP_Description, ST_MIN_LC, ST_MIN_LH};
{MP_ID→MP_Description, ST_MIN_LC, ST_MIN_LH})
DESC : The relation is in 3NF, 2NF, and 1NF as the relation has no multivalued attributes with a single attribute as its primary key with no transitive dependencies.

Vehicle Part (
{Part_ID, PR_Description, PR_Cost};
{Part_ID→PR_Description, PR_Cost})
DESC : The relation is in 3NF, 2NF, and 1NF as the relation has no multivalued attributes with a single attribute as its primary key with no transitive dependencies.

Employee (
{EID, Name, DOB, Degrees, Marital Status, Hire Date, SSN, EA_Start_Date, EA_End_Date, E_Street, City, State, Zipcode};
{EID→Name, DOB, Degrees, Marital Status, Hire Date, SSN, EA_Start_Date, EA_End_Date, E_Street, Zipcode;
Zipcode→City, State;
EID→Degrees})
DESC: This relation is not in 3NF as it has a transitive dependency; it also has a multivalued attribute.

Transaction Agent (
{EID, Commission Rate};
{EID→Commission Rate})
DESC : The relation is in 3NF, 2NF, and 1NF as the relation has no multivalued attributes with a single attribute as its primary key with no transitive dependencies.

Manager (
{EID, Promotion Date};
{EID→Promotion Date})
DESC : The relation is in 3NF, 2NF, and 1NF as the relation has no multivalued attributes with a single attribute as its primary key with no transitive dependencies.

Service Technician (
{EID, Hourly_LC_Rate, Level, Last Qualified Date};
{EID→Hourly_LC_Rate, Level, Last Qualified Date})
DESC : The relation is in 3NF, 2NF, and 1NF as the relation has no multivalued attributes with a single attribute as its primary key with no transitive dependencies.

Supplier (
{SUPP_ID, SUPP_TYPE}
{SUPP_ID→SUPP_TYPE})
DESC : The relation is in 3NF, 2NF, and 1NF as the relation has no multivalued attributes with a single attribute as its primary key with no transitive dependencies.

Qualifies (
{EID, MP_ID})
DESC : The relation is in 3NF, 2NF, and 1NF as the relation has no multivalued attributes with a single attribute as its primary key with no transitive dependencies.

Requires (

{MP_ID, PART_ID})
DESC : The relation is in 3NF, 2NF, and 1NF as the relation has no multivalued attributes with a single attribute as its primary key with no transitive dependencies.

Final RDM Conversion (3NF Justification):

Branch ({BR_ID, BR_Name, BR_Phone_Number, BM_Start_Date, BM_End_Date, BR_Street, City, State, Zipcode})
Step 1 : Zipcode (Transitive Determinant)
Step 2 : Location ({Zipcode, City, State};
Zipcode→City, State})
Step 3 : Branch ({BR_ID, BR_Name, BR_Phone_Number, BM_Start_Date, BM_End_Date,
BR_Street, Zipcode})

Manufacturer ({FR_ID, FR_YRSBUS, FR_Name, FR_Street, City, State, Zipcode})

Step 1 : Zipcode (Transitive Determinant)
Step 2 : Location ({Zipcode, City, State};
{Zipcode→City, State})
Step 3 : Manufacturer ({FR_ID, FR_YRSBUS, FR_Name, FR_Street, Zipcode})

Private Seller ({PC_ID, PC_Name, PC_RSCR, PC_Street, City, State, Zipcode})

Step 1 : Zipcode (Transitive Determinant)
Step 2 : Location ({Zipcode, City, State};
{Zipcode→City, State})
Step 3 : Private Seller ({PC_ID, PC_Name, PC_RSCR, PC_Street, Zipcode})

Vehicle ({VIN, Colors, CLN, Year, State}, {VIN→CLN, Year, State})

Step 1 : Colors (Multivalued Attribute)
Step 2 : COLOR ({VIN, Col_Selection, Color};
Step 3 : {VIN, Col_Selection→Col_Color})

Employee ({EID, Name, DOB, Degrees, Marital Status, Hire Date, SSN, EA_Start_Date, EA_End_Date, E_Street, City, State, Zipcode};)

Step 1 : Zipcode (Transitive Determinant)
Step 2 : Location ({Zipcode, City, State};
{Zipcode→City, State})
Step 3 : ({EID, Name, DOB, Degrees, Marital Status, Hire Date, SSN, EA_Start_Date, EA_End_Date, E_Street, Zipcode};)

Step 4 : Degrees (Multivalued Attribute)
Step 5: ({EID, Name, DOB, Marital Status, Hire Date, SSN, EA_Start_Date, EA_End_Date, E_Street, Zipcode};
{EID→Name, DOB, Marital Status, Hire Date, SSN, EA_Start_Date, EA_End_Date, E_Street, Zipcode})
Step 5 : EDU_LVL ({EID, DEG_Section, Degree};
{EID, DEG_Section→Deg_Degree})

Final RDM:

	Name	PK	Non-PK,FK Attributes	FK(s)
REGULAR ENTITIES	Procurement Transaction	TP_ID	TP_Amount, TP_Mileage, TP_Date	BR_ID, VIN, EID, SUPP_ID
	Branch	BR_ID	BR_Name, BR_Phone_Number, BM_Start_Date, BM_End_Date, BR_Street, Zipcode	EID
	Vehicle	VIN	Colors, CLN, Year, State	VMID, CID
	Vehicle Model	VMID	Name, Start_Year, End_Year, MilesPG	
	Sales Transaction	TS_ID	TS_Amount, TS_Mileage, TS_Date	BR_ID, CID, VIN, EID
	Maintenance Service Order	MO_ID	MO_Mileage, MO_Start_Date	BR_ID, CID, VIN, MSI_ID, EID
	Maintenance Problem	MP_ID	MP_Description, ST_MIN_LC, ST_MIN_LH	
	Vegicle Part	PART_ID	PR_Description, PR_Cost	
WEAK ENTITIES	Maintenance Service Item	MO_ID, MSI_ID	Actual Start Date, Actual End Date, Charged_L_Cost, Charged_L_Hour	MO_ID, EID, MP_ID
SUPERTYPE ENTITIES	Manufacturer	FR_ID	FR_YRSBUS, FR_Name, FR_Street, Zipcode	SUPP_ID
	Private Seller	PC_ID	PC_Name, PC_RSCR, PC_Street, Zipcode	SUPP_ID
	Customer	CID	Name, Address, Balance	SUPP_ID
	Employee	EID	Name, DOB, Degrees, Marital Status, Hire Date, SSN, EA_Start_Date, EA_End_Date, E_Street, Zipcode	BR_ID
SUBTYPE ENTITIES	Organization	CID		CID
	Person	CID	DOB, SSN	CID
	Transaction Agent	EID	Commission Rate	CID
	Manager	EID	Promotion Date	EID
	Service Technician	EID	Hourly_LC_Rate, Level, Last Qulified Date	EID
CATEGORIES	Supplier	SUPP_ID	SUPP_TYPE	
M:M RELATIONSHIPS	Qualifies	EID, MP_ID		EID, MP_ID
	Requires	MP_ID, Part_ID		MP_ID, Part_ID

Transformation of ERD to RDM: Individual Team Member Report	
Name of Team Member:	Jason Rogers, Adrian Brown, Christopher Lane
Detailed Description of what you did	

Our team worked well together. Every member displayed excellent communication skills, a highly focused resolve for completion of the work, and a willingness to broaden our understanding and scope of the project by including everyone's input.

Description of what you learned:

Our team gained a better understanding of ERD relational models and how to normalize relations to 3NF.