

Identification of the relations (entity types):

<i>Entity name</i>	<i>Description</i>	<i>Aliases</i>	<i>Occurrence</i>
RepairOrder	General term describing all repair order information.	Repair Order	Each repair order is specific to one particular vehicle. A particular vehicle can have many repair orders over time
Procedure	General term describing all procedures that can be done on a vehicle.	Service	A particular procedure can be used on many different repair orders, but doesn't have to be used on any. A repair order has at least one, but possibly many different procedures.
LineItem	General term describing all purchases (parts or labor) needed to complete a procedure.	Line Item	Any given line item can be present on 0 or more (possibly many) invoices. A single invoice contains at least one, but possibly many line items. A procedure may have many line items and a line item pertains to a specific procedure
LineItemPart	Specialization of LineItem	Parts	A Part is a type of line item
LineItemLabor	Specialization of LineItem	Labor	Labor is a type of line item
Invoice	General term describing the collection of all line items for a transaction.	Invoice, Bill	Each invoice is specific to one repair order. A repair order can have multiple invoices.
InvoiceEstimate	Specialization of Invoice, an	Estimate	An Estimate is a type of invoice.

	estimated cost of repairs.		
InvoiceCost	Specialization of Invoice, a payable bill.	Cost	A Cost is a type of invoice.
Vehicle	General term describing a vehicle being repaired.	Vehicle, Automobile, Car	Each vehicle can have many repair orders, a repair order is specific to one vehicle.
Mechanic	General term describing the staff member choosing the procedures.	Staff	Each mechanic can choose many procedures or none, any given procedure can be chosen by many mechanics or none. A mechanic can fulfill many repair orders or none, each repair order must be fulfilled by exactly one mechanic.

Identification of relationship types and their participation and cardinality constraints:

<i>Entity Name</i>	<i>Multiplicity</i>	<i>Relationship</i>	<i>Multiplicity</i>	<i>Entity Name</i>
RepairOrder	0..*	Fixes	1..1	Vehicle
	0..*	Documents	1..*	
	1..1	Generates	1..*	
Procedure	0..*	Requires	1..*	LineItem
Invoice	0..*	Lists	1..*	LineItem
Mechanic	0..*	Chooses	0..*	Procedure
	1..1	Fulfills	0..*	
				RepairOrder

Identification of attributes and association of attributes with entity or relationship types:

<i>Entity or relationship name</i>	<i>Attributes</i>	<i>Description</i>	<i>Data Type & Length</i>	<i>Nulls</i>	<i>Multivalued</i>
RepairOrder	repairNo (PK)	Uniquely identifies repair orders	VARCHAR 10	No	No
	originDate	Date when invoice is created.	DATE 10	No	No
	completeDate	Date when repair completes.	DATE 10	No	No
	complaintNote	Document containing complaints about vehicle.	TEXT	No	No
	vehicleNo (FK)	Identity of vehicle receiving repairs	VARCHAR 10	No	No
	staffNo (FK)	Identity of mechanic(s) in charge of repairs	VARCHAR 10	No	No
Procedure	procedureNo (PK)	Uniquely identifies procedures	VARCHAR 10	No	No
	procedureDescription	Gives a description of procedure	TEXT	No	No
LineItem	itemNo (PK)	Uniquely identifies a line item	VARCHAR 10	No	No
	itemName	Name of line item	VARCHAR 50	No	No
	description	Describes the line item	INTEGER	No	No
	procedureNo (FK)	Identify the procedure the line item is used for.	VARCHAR 10	No	No
				No	No
LineItemPart	price	Gives the price of the line item part.	DECIMAL (7,2)	No	No
LineItemLabor	rate	Gives hourly labor rate	DECIMAL (5,2)	No	No
	hours	Gives number of hours required for labor	DECIMAL (5,2)	No	No
			DECIMAL (7,2)	No	No

	price (derived as rate * hours)	Gives the price of the labor, derived from hourly rate and number hours.			
Invoice	invoiceNo (PK)	Uniquely identifies an invoice.	VARCHAR 10	No	No
	odometerStart	Odometer reading when repairs start.	INTEGER	No	No
	invoicePrintDate	Date that the invoice is printed	INTEGER	No	No
	repairNo (FK)	Reference to RepairOrder the invoice belongs to.	VARCHAR 10	No	No
InvoiceEstimate					
InvoiceCost	odometerFinish	Odometer reading when repairs finish.	INTEGER	No	No
	paymentDate	Date the invoice is paid for.	DATE	Yes	No
Vehicle	vehicleNo (PK)	Uniquely identifies a vehicle to be repaired.	VARCHAR 10	No	No
	vin	Vehicle vin number	VARCHAR 17	No	No
	make	Make of the vehicle	VARCHAR 50	No	No
	year	Year of the vehicle	YEAR	No	No
	model	Model of the vehicle	VARCHAR 50	No	No
Mechanic	staffNo (PK)	Uniquely identifies a mechanic	VARCHAR 10	No	No
Lists	quantity	Indicates the quantity of a particular line item in the relationship Invoice Lists Lineltem.	INTEGER	Yes	No
Documents	repairDocument	Document outlining the repair process.	TEXT	No	No

Determination of candidate and primary key attributes of entity types:

<i>Entity</i>	<i>Primary Key</i>	<i>Candidate Keys</i>
RepairOrder	repairNo	N/A
Procedure	procedureNo	N/A
LineItem	itemNo	itemName
Invoice	invoiceNo	N/A
Vehicle	vehicleNo	vin
Mechanic	staffNo	N/A

Determination of specialization/generalization and categorization relationships:

Specialization/Generalization Relationship:

- **Invoice (Mandatory and Disjoint)**
 - **Estimate**
 - **Final Bill**
- **Line Item (Mandatory and Disjoint)**
 - **Parts Line Item**
 - **Labor Line Item**

Aggregation Relationship:

- **Repair Order**
 - **Invoice**
 - **Procedure**
 - **Vehicle**
- **Invoice**
 - **Line Item**

