

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..* 0..* 1..1	Fixes Documents Generates	1..1 1..* 1..*	Vehicle Procedure Invoice
Procedure	0..*	Requires	1..*	LineItem
Invoice	0..*	Lists	1..*	LineItem
Mechanic	0..* 1..1	Chooses Fulfils	0..* 0..*	Procedure 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>Multi-valued</i>
RepairOrder	repairNo (PK) originDate completeDate complaintNote vehicleNo (FK) staffNo (FK)	Uniquely identifies repair orders Date when invoice is created. Date when repair completes. Document containing complaints about vehicle. Identity of vehicle receiving repairs Identity of mechanic(s) in charge of repairs	VARCHAR 10 DATE 10 DATE 10 TEXT VARCHAR 10 VARCHAR 10	No No No No No	No No No No No
Procedure	procedureNo (PK) procedureDescription	Uniquely identifies procedures Gives a description of procedure	VARCHAR 10 TEXT	No No	No No
LineItem	itemNo (PK) itemName description procedureNo (FK)	Uniquely identifies a line item Name of line item Describes the line item Identify the procedure the line item is used for.	VARCHAR 10 VARCHAR 50 INTEGER VARCHAR 10	No No No No No	No No No No No
LineItemPart	price	Gives the price of the line item part.	DECIMAL (7,2)	No	No
LineItemLabor	rate hours	Gives hourly labor rate Gives number of hours required for labor	DECIMAL (5,2) DECIMAL (5,2) DECIMAL (7,2)	No No	No No

	price (derived as rate * hours)	Gives the price of the labor, derived from hourly rate and number hours.			
Invoice	invoiceNo (PK) odometerStart invoicePrintDate repairNo (FK)	Uniquely identifies an invoice. Odometer reading when repairs start. Date that the invoice is printed Reference to RepairOrder the invoice belongs to.	VARCHAR 10 INTEGER INTEGER VARCHAR 10	No No No No	No No No No
InvoiceEstimate					
InvoiceCost	odometerFinish paymentDate	Odometer reading when repairs finish. Date the invoice is paid for.	INTEGER DATE	No Yes	No No
Vehicle	vehicleNo (PK) vin make year model	Uniquely identifies a vehicle to be repaired. Vehicle vin number Make of the vehicle Year of the vehicle Model of the vehicle	VARCHAR 10 VARCHAR 17 VARCHAR 50 YEAR VARCHAR 50	No No No No	No No 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 LineItem.	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**

