

DATABASE DESIGN AND IMPLEMENTATION

1. Conceptual Model [Updated]

b. Normalization

Original Tables/Views:

SalesInvoice (InvoiceNo, Date, CustomerName, Address, City, State, Tel_No, Postal_code, SerialNo, Make, Model, Year, Color, Insurance, Code, Description, Price, TotalPrice, Allowance, Net, Discount, Taxes, Total_Payable, SalesPerson_ID, SalesPerson)

VehicleInventory(SerialNo, Make, Model, Year, ExteriorColor, Trim, PurchasedFrom, Purch.Inv.No, PurchaseDate, PurchaseCost, ListBasePrice, Code, Description, ListPrice)

VehicleSales(Sales_Inv_No, SerialNo, Freight, Tax, Licence, Others, Commission, Total)

ServiceBusiness(ServiceInvoiceNo, Date, SerialNo, Work_to_Be_Done), Parts, Labor, Tax, Total)

ServiceLog (ServiceInvoiceNo, Date, SerialNo, TotalCost)

Prospect (CustomerName, Year, Color, Make, Model, Trim, Option, Code, Option)

All tables above appear to be in 2NF because each has a single field primary key (i.e., Invoice No, Serial No), and hence there is no issue of partial dependence. To illustrate, the Sales invoice table has one primary key, namely, InvoiceNo, which uniquely identifies rows or tuples in the database. There are no cases of a field depending on only one of the fields in a combined primary key. It is also in 2NF because they are non-key fields depending on other non-key fields.

Conversion from 2NF to 3NF

A table is in 3NF if it is in 2NF and no nonkey field depends on another non-key field. For instance, the SalesInvoice Table shows non-key fields, such as make, model, year, and color, depending on another non-key field, SerialNO. Also, Salesperson, a non-key field, depends on salesperson_ID, and Description and Price depend on Code (non-key)

For VehicleInventory table, we notice non-key fields, such as PurchaseDate, and PurchaseCost depend on another non-key field, Purch_Inv_No. The same applies to VehicleSales, ServiceBusiness, etc.

Therefore, to convert the table to 3NF, I removed all fields from the 2NF that depend on other non-key fields and placed them in a new relation. For instance, we will remove fields such as Make, Model, Year, Color, and place them in a new table (let's name it carsInventory) that uses SerialNo as the primary key. The same approach was used to create the other tables shown below:

Inventory (SerialNo, Make, Model, Year, Color, InsuranceCoverage, Allowance, BasicCarPrice)

Options (Code, Description, Price)

Customer (Customer_ID, CustomerName, Telephone_No, Address_ID)

Address (Address_ID, PostalCode, City, State)

SalesInvoice (InvoiceNo, Date, TotalPrice, Discount, Net, Taxes, Freight, License, Other, Commission, TotalPayable, SerialNo, Code, Salesman_ID, Customer_ID)

Service (ServiceInvoiceNo, Date, Work_to_Be_Done, Parts, Labor, Tax, Total, SerialNo)

Purchases (Purch_Inv_No, PurchasedFrom, PurchaseDate, PurchaseCost, ListBasePrice, SerialNo, Code)

ProspectList (ProspectID, Customer_ID, Code)

The tables above are in 3NF. It is worthwhile to note that relations that had same primary key (i.e., InvoiceNo) were merged into one. The last step is to remove calculated fields, also known as derived attributes (i.e., Net, all Totals), from our relations in order to make the database more efficient and save storage space.

Final 3NF Tables:

CarInventory (SerialNo, Make, Model, Year, Color, InsuranceCoverage, Allowance, BasicCarPrice, Code(fk))

Options (Code, Description, Price)

Customer (Customer_ID, CustomerName, Telephone_No, Address_ID (fk))

Address (Address_ID, PostalCode, City, State)

SalesInvoice (InvoiceNo, Date, TotalPrice, Discount, Taxes, Freight, License, Other, Commission, SerialNo, Code, Salesman_ID, Customer_ID (fk))

Service (ServiceInvoiceNo, Date, Work_to_Be_Done, Parts, Labor, Tax, SerialNo)

Purchases (Purch_Inv_No, PurchasedFrom, PurchaseDate, PurchaseCost, ListBasePrice, SerialNo, Code (Fks))

ProspectList (ProspectID, Other Description Customer_ID, Code(fk),)

References

Li, Q., & Chen, Y. L. (2009). Entity-relationship diagram. In *Modeling and analysis of enterprise and information systems* (pp. 125-139). Springer, Berlin, Heidelberg.