

Let Us Kick Start With Conceptual Data Modeling



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General Points To Note

- **Conceptual Data Model is Generic And is The First Data Model That is Created in Any System Development Life Cycle.**
- **The Conceptual Data Model Has No Considerations About The Type of Database System Being Implemented.**
- **Conceptual Data Model Has No Reference To The Particular Database Management System(DBMS).**
- **Conceptual Data Model Has No Concern About The Storage And Hardware Environment Where The Ultimate Data of The Business System Will Reside And Operates.**
- **There Are Several Different Standard Techniques And Notations For Creating A Data Model.**
- **Basic Symbols And Notations Are Almost Standardized in Most of The Techniques.**

Points To Concentrate

- **We Should Use Meaningful And Easily Understood Symbols in The Initial Design.**
- **The Main Goals in Conceptual Data Modeling Are Identification of Major Components of A Data Subjects OR Objects in The Business System.**
- **Conceptual Data Model Should Process Only The Major Steps Indicating The General Association Between Objects And Subjects of The Business System.**
- **Conceptual Data Model Should Be Communication Tool.**



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Let Us Understand The Data Model Components



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Objects OR Entities

- We Should Analyze The Information Requirements of A Company, The Components That Represent The Information Requirements of A Company Are Called As "Objects" OR "Entities".
- The Business System Should Know How These Business Objects Are Related And The Implications of Such Relationships in The Business Process.

Scenario 01

Domain → Banking System

Process of Analysis

- A Bank is Interested in The Data About its Customers And Their Accounts, Savings, And Loan Accounts.

Objects OR Entities Identified

- Customer
- Checking-Account
- Savings-Account
- Loan-Account

Scenario 02

Domain → Hospital System

Process of Analysis

- A Hospital is Interested in The Data About its Chain of Hospitals, Patients, Physicians, Treatment Procedures, And Hospital-Visits.

Objects OR Entities Identified

- Hospital
- Patient
- Physicians
- Treatments
- Patient Visits



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Things To Note

- Every Business Organization Has its Own Set of Business Objects.
- A Particular Institution Needs Data About its Own Set of Business Objects And its Own Business Operations.
- Data About The Business Objects OR Entities Must Be Present in The Database System For The Organization To Function Through its Business Processes.

Attributes OR Characteristics

- When We Consider A Specific Business Object, This Business Object Any Where in The Business System Should Represent Similar Characteristics.
- The Representation of Intrinsic Characteristics That Are Describing The Nature of Existence of The Business Object in The Business System Are Called As Attributes.
- Each Individual Attribute Identified on The Business Object Should Contain A Distinct Identifiable Value in The Business Process.
- Attributes of An Object OR Entity Are Representations of its Inherent OR Intrinsic Characteristics of The Business Object in The System.
- With in The Entity OR Object The Attributes Should Be Unique By Nature And They Should Represent Only To That Business Object But Should Not Describe Others.



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Illustrative Examples For Attribute Identification



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Customer

- Customer Name
- Customer Address
- Customer Phone Number
- Customer Email ID
- Customer Balance Amount

Checking-Account

- Account Min Balance
- Account Max Balance
- Min Check Leafs
- Max Check Leafs
- Bounce Instructions
- Max Check Books in A Year

Savings-Account

- Account Min Balance
- Account Max Balance
- Min Withdraw in A Day
- Min Amount For Withdraw
- Max Amount For Withdraw
- Min Amount For Deposit
- Max Amount For Deposit

Loan Account

- Min Loan Amount
- Max Loan Amount
- Loan Type
- Repayment EMI's

Hospital

- Hospital Name
- Hospital Address
- Hospital Phone Number

Physician

- Physician Name
- Physician Specialization
- University Name
- Date of Registration To MCI
- Consultation Charges

Treatments

- Treatment Name
- Treatment Cost
- Number of Sitzings
- Treatment Instructions

Patient

- Patient Name
- Patient Address
- Patient Phone Number
- Patient Complaint
- Insurance Bit

Patient Visits

- Patient Name
- Patient Visit Date
- Physician Name
- Hospital Name



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Let Us Understand The Concept of Identifiers



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- Frequently in Business Operations We Need To Find Information About A Single Instance of The Business Object.
- In Practice, One OR More Attributes Whose Values Would Uniquely Determine Specific Instances of An Object in The Business Process Are Chosen As The Identifier For That Object.

Strategy of Analysis

Domain of Concentration : Customer Analysis

Point of Ambiguity

- Customer Represents All The Customers of The Organization.
- Each Customer Has A Distinct Set of Values For The Attributes of The Object CUSTOMER.
- If The CUSTOMER Object Represents All And Every Customer in The Business Process, Then How Can We Distinguish One Customer From Another Represented Through The Object Called CUSTOMER?

Why Do We Need To Make This Distinction?

- In Business Situations, We Need To Find Information About A Single Customer While The Business Operations Are Conducted.

Questions That Arise

- Where Does The Customer Live?
- Where To Send The Invoices To The Customer?
- What Are The Recent Orders Placed By That Customer?
- How To Distinguish One Customer From Another And Indicate This Distinction in The Data Model?

Solution To Fix The Ambiguity

- Allocate A Unique CustomerNumber To Each Customer Registered, Under The CustomerNumber Attribute That is Registered in The Customer Entity.

Final Conclusion

- The Attribute CustomerNumber Will Be Recognized As An Identifying Attribute OR An Identifier For The Object CUSTOMER.



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Let Us Understand The Concept of Relationships



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- Relationships Are Instances That Make The Designer, Developer And The End User Identify The Communication Standards And Strategies Between The Business Objects.
- Relationships Are The Actual Standards That Help in Validating The Consistency of The Data Between The Sharable Objects in The Business System.

Strategy of Analysis

Domain of Concentration : Customer Analysis

Area of Concentration

- The Objects CUSTOMER And CHECKING-ACCOUNT Are Two Separate Objects With Their Own Attributes.

Actual Business Operation Analysis

- For The Purpose of Running The Banking Business, The Users in The Bank Need The Data About Customers And Checking Accounts.
- The Banking Business Needs The Data About These Two Objects Separately, But Also Simultaneously Needs To Know About The Relationship Between Customers And Their Checking Accounts.

Questions Raised

- For A Particular Customer, What is The Status of The Customer's Checking Account?
- What is The Relationship Between CUSTOMER And CHECKINGACCOUNT?

Where is The Relation?

- Customers Operate The Checking Accounts.

Final Conclusions

- In A Company's Environment, Business Objects Do Not Exist in Isolation. They Are Always Related To One Another.
- For A Data Model To Be A True Representation of The Real-World Then The Model Must Reflect The Relationships Among The Business Objects.



Let Us Catch The Simple Symbols in Data Modeling



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- To Make The Data Models Easy To Understand And Analyze The Concept of Data Modeling Assigns Some Simple Symbols To These Components.

Symbols To Identify

Square Box

- A Square Box is Used To Represent A Business Object.



Circle OR Ellipse

- Circles OR Ellipses Are Connected To A Square Box Representing The Attributes.
- Two Concentric Circles Are Used To Represent Identifiers.



Relationship OR Association

- When Two Objects Are Directly Related, The Relation is Indicated By Joining The Two Square Boxes By A Straight Line.



Relation

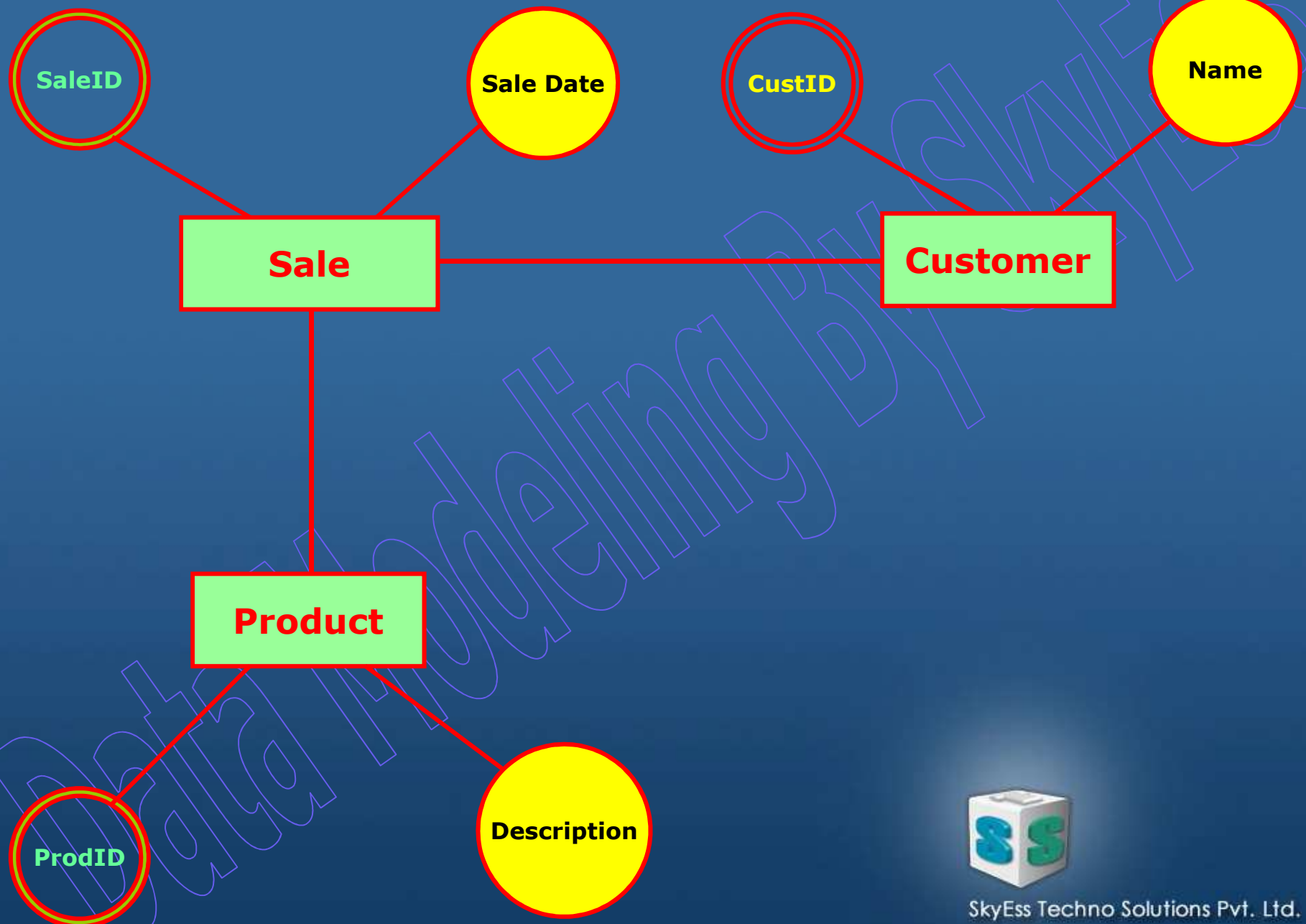


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Let Us Represent A Simple Model



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Let Us March With Data Modeling Steps



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Business Domain → Catering Management System

Company Name → Flavor Caterers

Services Offered

- **Flavor Caterers Offer Catering Management And Services For**
 - **Birthday Parties**
 - **Anniversaries**
 - **Student Reunions**
 - **Small Business Luncheons**
 - **Marriages And Receptions**

Number of Owners

- **Two Owners Both Belonging To The Same Family**

Components of Business Operations in Each Project

- **Have Four Permanent Employees And Also Use Temporary Employees Whenever The Need Arises.**
- **Clients Specify The Type of Food To Be Served And Also The Number of People To Be Served.**
- **Flavor Caterers Charge The Client on A Per-Plate Basis.**
- **Permanent And Temporary Employees Working on A Project Are Compensated Based on The Targets Achieved From The Project.**
- **Twenty-Five Percent of The Revenues From Each Project is Shared Among The Employees Working on That Project.**
- **In Order To Run The Catering Business, The Owners of The Business Have To Perform Various Business Processes.**



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Business Processes To Be Concentrated

- Plan For New Projects
- Assign Employees To Projects
- Bill Clients As Per The Contract
- Receive Payments
- Compensate Employees

Data Model Creation Process Steps

Step 1 → Business Objects Identification

- The Data Modeler Should Identify The Business Objects About Which Data Will Be Needed.

How To Know The Business Objects And Data?

- The Data Modeler Should Examine And Study The Business Processes That Are Necessary To Run The Business In The Domain.

What Are The Responsibilities of The Data Modeler?

- The Data Modeler Should Note Down The Major Business Processes That Are Influencing To Run The Business.
- The Information That is Influencing in Conducting OR Carrying Out These Business Processes.
- Examine Each of The Business Processes Closely And Pin Point The Area of Relations That Are Arising.
- Examine The Objects in The Business That Are Stimulating The Business Process And Are Closely Integrated Through Out The Business Process.



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Let Us Start Dissecting The System



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Business Process 01 → Plan For Projects

Question of Concentration

- For Performing The Catering Services What Kind of Data The Business Needs?

Answer Achieved Through Analysis

- Data About Clients
- Data About The Scheduled Projects
- The Type of Food Items To Be Served At The Projects

Final Conclusion To The Question

- List The Data Item Names That Can Act As Data Centers
 - ClientName
 - ClientPhone
 - DateOfProject
 - NumberOfGuests
 - EstimatedCost
 - TypeOfFood

Business Process 02 → Assign Employees To Projects

Question of Concentration

- For Assigning Employees To Projects And Making One Employee Responsible To The Project What Data The Business Needs?

Answer Achieved Through Analysis

- Data About The Client
- Data About The Project
- Data About The Employee



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Final Conclusion To The Question

- **List The Data Item Names That Can Act As Data Centers**
 - **ClientName**
 - **DateOfProject**
 - **EmployeeName**

Business Process 03 → **Bill Clients**

Question of Concentration

- **For Performing The Process of Billing The Clients, What Data The Business Needs?**

Answer Achieved Through Analysis

- **Raise The Invoices Upon The Client on The Project**
- **Send The Invoices To The Clients For The Projects Served**

Final Conclusion To The Question

- **List The Data Item Names That Can Act As Data Centers**
 - **ClientName**
 - **ClientAddress**
 - **ClientCity**
 - **ClientState**
 - **Clientzip**
 - **DateOfProject**
 - **NumberOfGuests**
 - **AmoutCharged**
 - **DueDateOfInvoice**
 - **MinimumAmountOfTheInvoice**



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Business Process 04 → Receive Payments

Question of Concentration

- For Receiving The Payments OR After Receiving The Payments From The Clients What Data The Business Needs?

Answer Achieved Through Analysis

- Data About The Payment Received
- From Whom The Payment is Received

Final Conclusion To The Question

- List The Data Item Names That Can Act As Data Centers
 - ClientName
 - DateOfProject
 - PaymentDate
 - TypeOfPayment
 - AmountPaid
 - AmountDue

Business Process 05 → Compensate Employees

Question of Concentration

- For Compensating The Employees What Data The Business Needs?

Answer Achieved Through Analysis

- The Company Must Have Information About Each Project
- The Employees Who Worked on That Specific Project
- The Kind of Role That Employee Played in That Specific Project
- The Total Amount Charged For That Project



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Final Conclusion To The Question

- **List The Data Item Names That Can Act As Data Centers**
 - **DateOfProject**
 - **AmountCharged**
 - **EmployeeName**
 - **EmployeeSSN**

Final Responsibility of The Data Modeler To Conclude This Phase

- **Collect And Complete The List of Data Items That Would Be Required For All The Business Processes That Are Identified.**
- **Examine The List of Data Items That Are Identified And Group The Data Items Together That Are About The Same Thing.**

What is This Process Called As?

- **Process of Aggregation**

What is The Necessity of Aggregation?

- **Aggregation Results in The Ability To Identify The Business Objects That Are Necessary To The Business Processes.**

The Final Phase Achieved

- **The Data Items Are Belonging To The Following Business Objects Which Are Source of Driving The "Flavor Caterers"**
 - **CLIENT**
 - **PROJECT**
 - **EMPLOYEE**
 - **FOOD TYPE**
 - **PAYMENT**



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Identifying Direct Relationships



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- In Any Business Organization, The Business Objects Are Interrelated.
- Objects in The Business Environment Are Likely To Be Connected By Direct Relationships.
- A Data Modeler Should Examine Each Pair of Potentially Related Objects in The Business Process.
- At This Stage The Data Modeler Should Not Concentrate on Any Indirect OR Transitive Relations.
- That Data Modeler Main Area of Concentration Should Be Only on Looking For Potential Relationships.

Direct Relations Identified For "Flavor Caterers"

- Employees Are Assigned To Projects.
- Projects Use Food Types.
- Clients Order Projects.
- Client Makes Payments For Projects.

Relation Phrase Identification

- Identify The Describing Phrase in The Direct Relationship And Make The Pairs of Business Objects.
- The Relational Phrase Can Be Any Meaningful English Word(s)

Pairing The Objects of "Flavor Caterers"

- **EMPLOYEE** → **Assigned To** → **PROJECT**
- **PROJECT** → **Uses** → **FOOD TYPE**
- **CLIENT** → **Orders** → **PROJECT**
- **CLIENT** → **Makes** → **PAYMENT**



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Analyzing The Cardinalities on Direct Relationships



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- Information in The Analyzed Data System Must Tell The Data Modeler And The Business Owner Which "Business Object" is Assigned To Which Other "Business Object" in The System.
- Every Business System Has Few Restrictions on The Relationship Between The Business Objects.
- The Aspect of The Relationship Identified in The Business System is Called As "Cardinality of The Relation".
- The Cardinality Indicators Applied in Data Modeling
 - "*" → Indicates Many
 - "1" → Indicates One
- The Cardinality Indicator Indicates How Many Instances of One Object May Be Related To How Many Instances of The Other Object in The Business Process.
- The Data Model Represented By The Data Modeler Should Represent Relations Among The Business Objects As Well As Their Cardinalities in The Business Process.
- The Cardinality on The Relation Helps The Programmers At Later Stages.

What Restrictions "Flavor Caterers" Have on Their Relations?

At Employee To Project Level

- One Employee May Be Assigned To One OR More Projects.
- One Project Can Have One OR More Employees.

Final Conclusion on Cardinality

- **Many-To-Many Relationship**



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At Client To Project Level

- One Client Can Order One OR More Projects.
- One Project Can Have Only One Client

Final Conclusion on Cardinality

- One-To-One Relationship

At Project To Food Type Level

- One Project Can Use One OR More Food Types.
- One Food Type Can Be Uses in One OR More Projects

Final Conclusion on Cardinality

- Many-To-Many Relationship

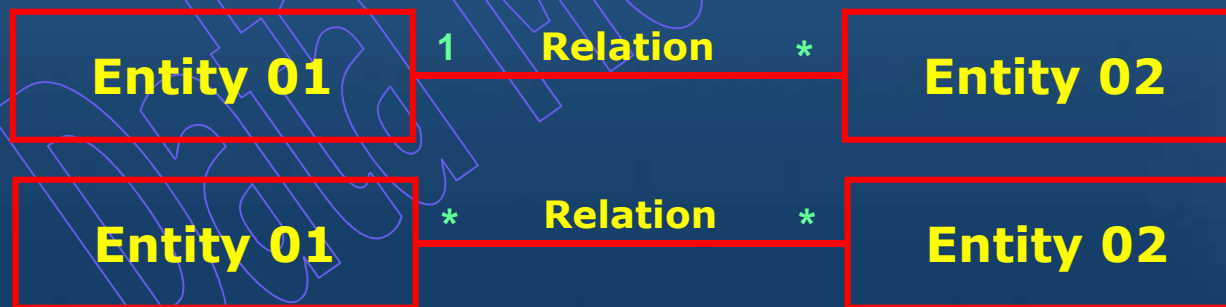
At Client To Food Payment Level

- One Client Can Make One OR More Payments.
- One Payment Can Be Authorized For Only One Client

Final Conclusion on Cardinality

- One-To-One Relationship

Representing Cardinalities in The Data Model

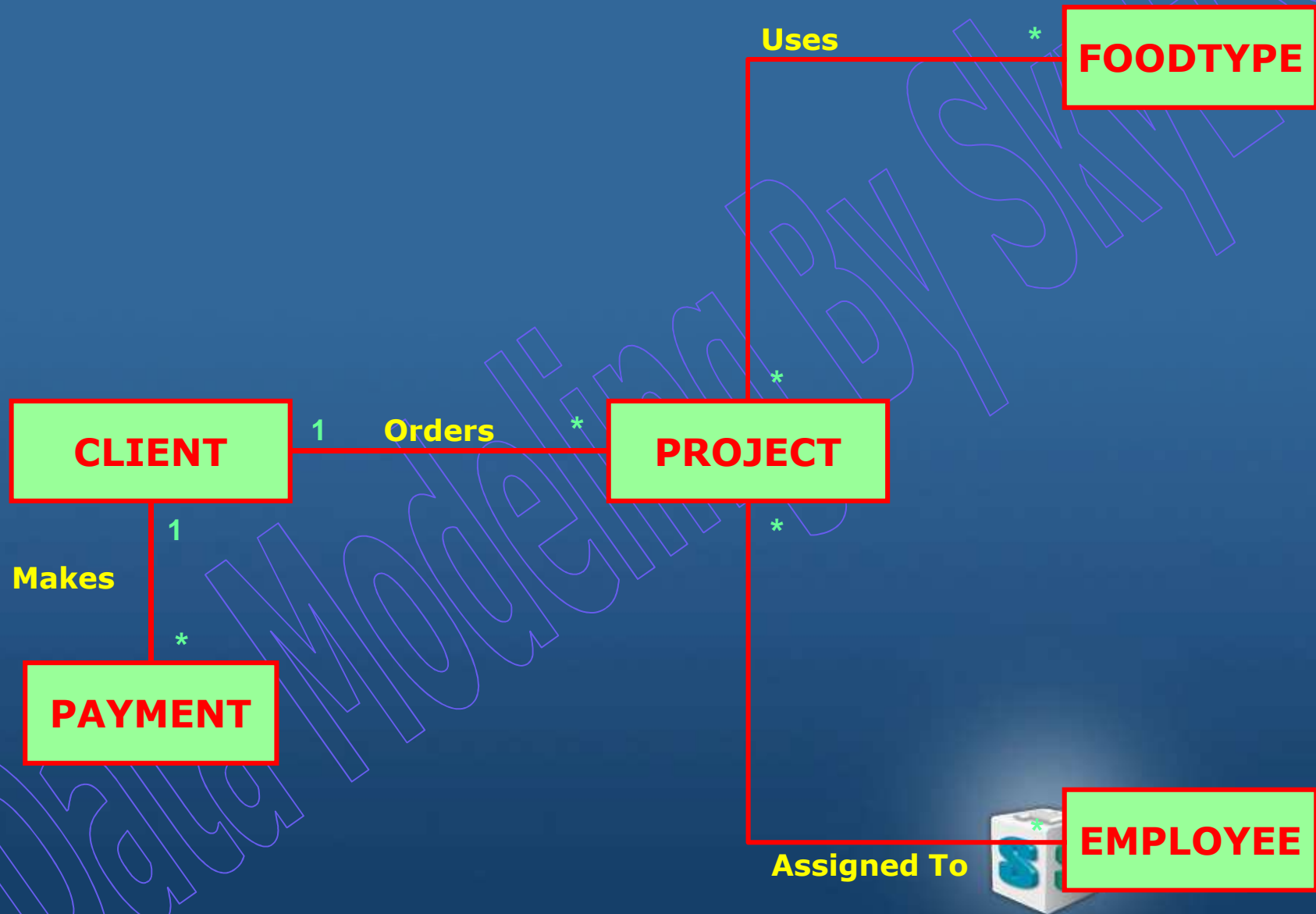


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The Final Picture At This Level



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Let Us Add The Descriptive Components



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- Attributes Describe The Business Objects That Are Participating In The Business Process Of The Business System.
- After Identifying The Business Objects And Determining The Relationships Among The Objects, The Next Immediate Step The Data Modeler Has To Undertake Is To Include The Attributes.
- By Adding The Attributes The Data Model Diagram Becomes Even More Complete.
- The List Of Data Elements Identified In The Requirements Analysis Phace Will Form The Set Of Attributes.

Attribute Identification Process

CLIENT

Name
Address
City
State
Zip
Phone

PROJECT

Date
NoOfGuests
EstimatedCost
AmontCharged

EMPLOYEE

SSNNumber
EmpName

FOOD TYPE

Foodname

PAYMENT

Date
PaymntType
Amount



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Let Us Analyze The Identifiers in The System



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- An Identifier For A Business Object is One OR More Attributes Whose Values Uniquely Identify Individual Instances of The Object.
- The Data Modeler Should Examine The Set of Attributes For Each Object And Determine Which Ones Are Best Suitable Candidates To Be An Identifier.
- If None of The Known Attributes of An Object Qualifies To Be An Identifier, Then The Data Modeler Has To Introduce One OR More New Attributes To Form The Identifier.

CLIENT

- ClientNo

PROJECT

- ProjectNo

EMPLOYEE

- SSNumber

FOOD TYPE

- TypeID

PAYMENT

- PymntSeq

Note

- The Identifier Columns That Are Externally Added By The Analyst OR Data Modeler Should Reflect To The Standards of The Clients Business Environment.
- The Identifier Columns Should Be Designed in Such A Way That Every Attribute in The Business Domain of That Entity Should Depend Directly on The Identifier Attribute.



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The Final Big Picture At This Level



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