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Entity Relationship Models

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What is an Entity Relationship Diagram?

An entity relationship diagram is a graphical representation of an organisation's data storage requirements.

Entity relationship diagrams are abstractions of the real world which simplify the problem to be solved while retaining its essential features.

Entity relationship diagrams are used to:

- identify the data that must be captured, stored and retrieved in order to support the business activities performed by an organisation; and
- identify the data required to derive and report on the performance measures that an organisation should be monitoring.

Entity relationship diagrams have three different components:

- ENTITIES
- ATTRIBUTES
- RELATIONSHIPS

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Entities

These are the people, places, things, events and concepts of interest to an organisation. In short, anything which an organisation needs to store data about.

Entities are represented on the diagram by labelled boxes.

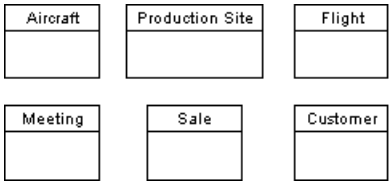

Figure 1: Representing Entities

Entities represent collections of things. For example, an EMPLOYEE entity might represent a collection of all the employees that work for an organisation. Individual members (employees) of the collection are called occurrences of the EMPLOYEE entity.

Because the available space for naming the entity is restricted to the size of the box, Entities should always have detailed descriptions. These detailed descriptions are usually short paragraphs of text describing the entity in more detail but for some important entities, a lengthy description may be required.

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Attributes

Entities are further described by their attributes (sometimes called data elements). These are the smallest units of data that can be described in a meaningful manner.

For example, an EMPLOYEE entity may have the following Attributes:

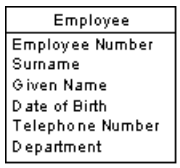

Figure 2: Entity Attributes

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Relationships

Frequently, a meaningful relationship exists between two different types of entity.

For example:

- EMPLOYEEs work in a DEPARTMENT
- LAWYERs advise CLIENTs
- EQUIPMENT is allocated to PROJECTs
- TRUCK is a type of VEHICLE

There are potentially three types of relationship which can exist between two different entities:

- One-to-One Relationships
- One-to-Many Relationships
- Many-to-Many Relationships

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One-to-One Relationships

This type of relationship takes place when a single occurrence of an entity is related to just one occurrence of a second entity.

For example, a ROOF covers one BUILDING; a BUILDING is covered by one ROOF.

A One-to-One relationship is shown on the diagram by a line connecting the two Entities

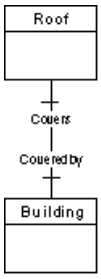

Figure 3: One-to-One Relationship

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One-to-Many Relationships

This type of relationship takes place when a single occurrence of an entity is related to many occurrences of a second entity.

For example, An EMPLOYEE works in one DEPARTMENT; a DEPARTMENT has many EMPLOYEEs.

A One-to-Many relationship is shown on the diagram by a line connecting the two entities with a *crows feet* symbol denoting the "many" end of the relationship.

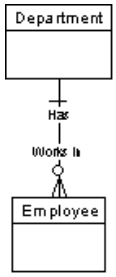

Figure 4: One-to-Many Relationship

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Many-to-Many Relationships

This type of relationship takes place when many occurrences of an entity are related to many occurrences of a second entity.

For example, EQUIPMENT is allocated to many PROJECTs; A PROJECT is allocated many items of EQUIPMENT.

A Many-to-Many relationship is shown on the diagram by a line connecting the two entities with a *crows feet* at each end of the line.

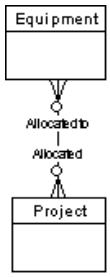

Figure 5: Many-to-Many Relationship

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Eliminating Many-to-Many Relationships

Many-to-many relationships in an entity relationship diagram tend to conceal areas of poor understanding.

Almost always, a many-to-many relationship conceals a *hidden* entity.

For this reason many-to-many relationships are eliminated by identifying and adding the *hidden* entity to the model.

The new entity is related to the two original entities by a pair of one-to-many relationships.

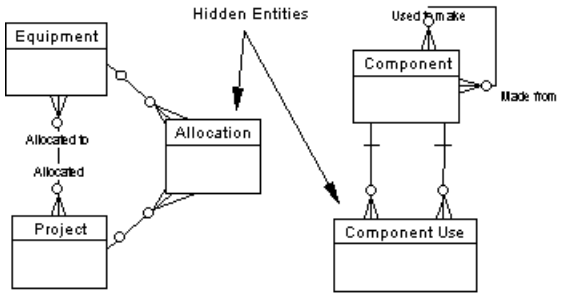

Figure 6: Identifying *Hidden* Entities

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Choosing the Right Relationship

Depending on the purpose of the model, the length of time involved, and the definition of the entities participating in the relationship, the type of relationship between two entities can change.

For example, if the definition of a ROOF entity is *an apex or flat surface covering a building*, then a BUILDING is covered by many ROOFs.

Likewise, over a period of time, an EMPLOYEE works in many DEPARTMENTS.

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Optional and Mandatory Relationships

Sometimes the participation of an entity in a relationship is optional. At other times it is mandatory.

For example, EQUIPMENT may be allocated to PROJECTs, an EMPLOYEE must work in a DEPARTMENT and a DEPARTMENT may have EMPLOYEEs working in it..

Optional participation in a relationship is shown by a circle placed on the relationship line next to the entity that optionally participates in the relationship.

Mandatory participation is shown in a similar manner by placing a bar on the relationship line.

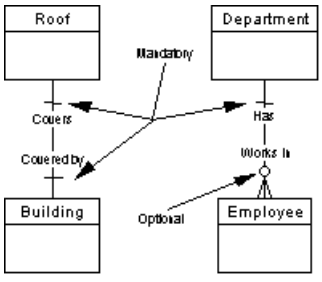

Figure 7: Optional and Mandatory Participation in Relationships

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Recursive Relationships

Relationships can exist between different occurrences of the same type of entity.

For example, A PERSON dances with another PERSON, an EMPLOYEE manages other EMPLOYEEs and a COMPONENT is made from other COMPONENTs

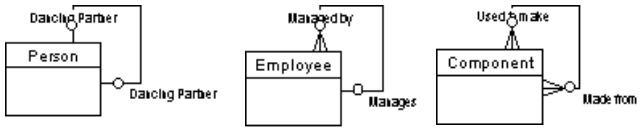

Figure 8: Recursive Relationships

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Entity Sub-Types

Sometimes it is useful to generalise about a group of Entities which have similar characteristics. For example a VEHICLE is a generalisation of a CAR, a TRUCK and a MOTORCYCLE.

Conversely, it can be useful to identify specialised sub-types of an entity. For example, a CAR is a specialised type of VEHICLE, a TRUCK is a specialised type of VEHICLE and a MOTORCYCLE is a specialised type of VEHICLE.

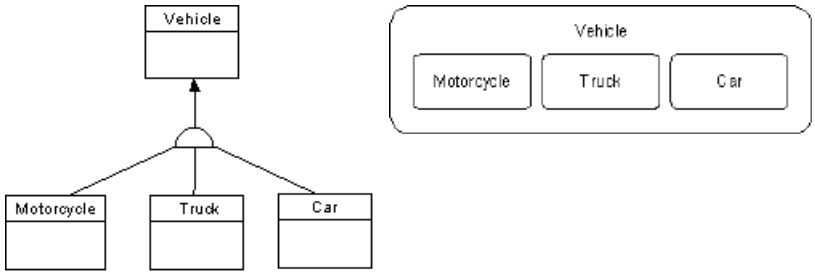

Figure 9: Two Styles of Sub-Type

There are two alternative styles commonly used to show Entity Sub-Types. One style illustrated by the diagram on the left, depicts each sub- and super-type as a separate box connected by lines. The style illustrated by the diagram on the right, encloses sub-types entirely within their super-type box. Both diagram have exactly the same meaning.

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Subject Areas

If entity relationship diagrams for a large, complex area of an organisation are constructed, the model itself becomes large and complex. Large, complex models can be of limited use in simplifying the problem to be solved.

The solution is to subdivide a large, complex entity relationship diagram into a number of Subject Areas. Each Subject Area focuses on a single aspect of the problem.

For example, a model depicting the *Human Resource* data required by an organisation could be subdivided into the following Subject Areas:

- Recruitment
- Safety
- Payroll
- Rostering

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Repository

The Repository compliments an Entity Relationship diagram by providing a place to store all of the detailed definitions which accompany the diagram.

The Repository can contain:

- Entity Descriptions
- Definition of an Entity's Attributes
- Attribute Descriptions
- Relationship Definitions

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Normalisation

Normalisation is a systematic procedure for grouping and assigning a number of Data Elements to Entities which are easy to update and will not contain redundant data.

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References

Open HorizoNZ - White Papers
A useful collection of white papers on data modelling and this company's approach to it.

Entity Modeling: Techniques and Application, Ronald, G. Ross, 1987, Database Research Group.

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