Starting shortly

Please wait!

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Data modelling for humanitarian and development information management systems

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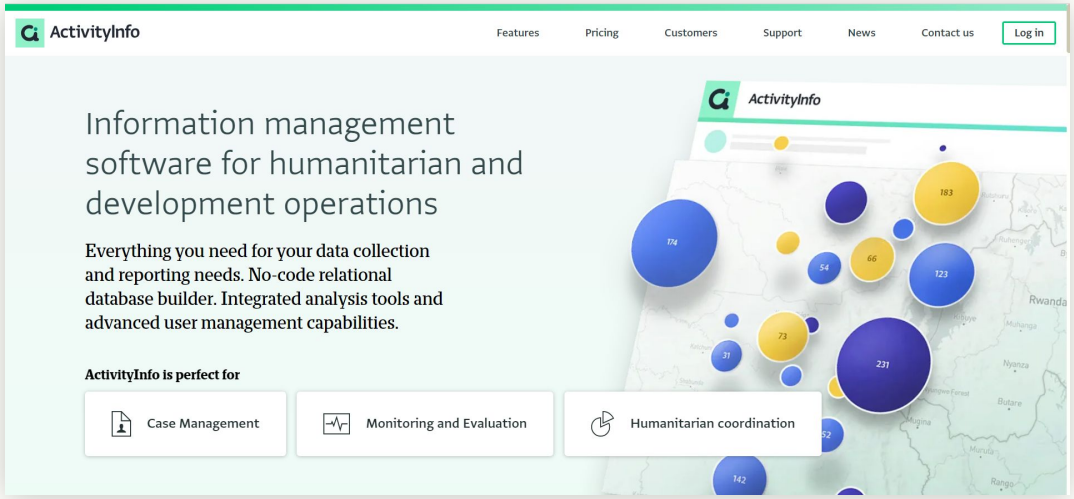
INTRODUCTIONS

Presented by the ActivityInfo Team

All in one information management software for humanitarian and development operations

- Track activities, outcomes
- Beneficiary management
- Surveys
- Work offline/online



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POLL

1. How would you rate your familiarity in designing databases?
    a. Beginner, I’m not really sure where to start
    b. Intermediate, I know a bit but am looking to improve
    c. Advanced, I already know how to design effective databases

2. How long have you been using ActivityInfo for, if at all?
    a. A few weeks
    b. A few months
    c. Over a year
    d. I haven’t used ActivityInfo yet

Agenda

1. Introductions and Housekeeping
2. How can we design data models?
    a. What is a data model?
    b. Why do we need a data model?
    c. What are the components of the data modelling process?
3. Data modelling best practices
    a. Considering the role of end user experience
        i. Tips for aligning user experience with database functionality
    b. Creating data models that facilitate analysis
        i. The most common data models in humanitarian and development contexts
4. Q&A

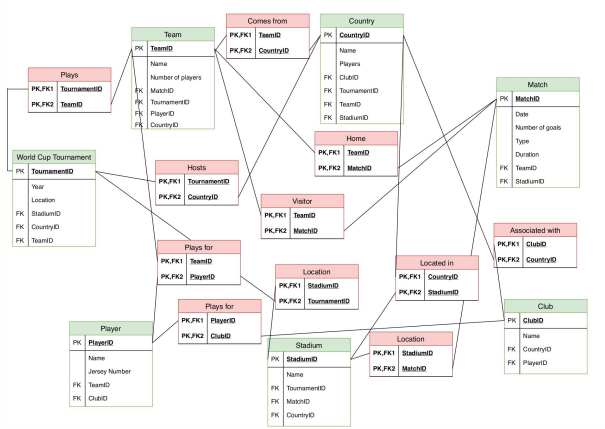
How can we design data models?

How can we design data models?

What is a data model?

A data model is a **visual representation** of a conceptual framework that organizes and defines data elements and shows how they interact with each other.

By mapping out data structures and their relationships in a visual format, it provides a method by which data is stored, organized, and retrieved.



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How can we design data models?

The challenge of humanitarian and development action

Nature of humanitarian and development action

1. Complexity of social and natural phenomena
2. The complexity of the expected behavior stems from the following characteristics :
   a. Emergent: It cannot be explained from the behavior of individual components but is said to emerge from the interactions between individual components
   b. Non-linear: Due to the ways in which interactions between the multiple components of the system accumulate, small changes in the behavior of individual components may result in disproportionate effects on the global state of the system.
   c. Adaptive: Individual components of the system can change their behavior to adapt to changes in the behavior of other components.

Source: Complex systems modeling for humanitarian action

How can we design data models?

Why do we need the data model?

01	Data organization and integrity	• structure data, thus easier to store, retrieve, and manipulate • data integrity by defining rules and constraints
02	Security	• Who needs to access data and why • Policy requirements
03	Scalability and documentation	• Blueprint on how data can be expanded • provide a clear and structured representation of the data,
04	Data integration	• Organizations have multiple data sources • Define how different systems relate
05	Communication	• common language for communication between different stakeholders

Accuracy, reliability, consistency, efficiency

Data protection

Maintenance and improvements

Facilitate data consolidation

Shared understanding

Leads to..

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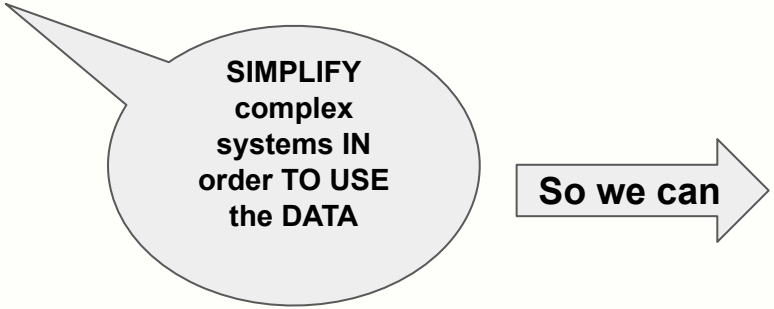
How can we design data models?

Where a efficient data model leads?

Monitor evaluate, be accountable and learn effectively



- Effective and data-driven humanitarian and development response:
  - understand the likely evolution of the situation at different time scales
  - enable responders and policy makers to better understand the short and long-term impacts of planned response activities (intended/unintended)
  - understand how to better coordinate humanitarian and development activities

How can we design data models?

How we can design a data model: An analogy

Identify entities and attributes

Dishes on the restaurant's menu. Each dish (entity) has a unique name

And specific ingredients (attributes).

Define relationships

Reduce data duplication

As a chef combines various dishes to create a meal,

The art of organizing your ingredients and utensils efficiently in the kitchen

How can we design data models?

How we can design a data model: An analogy

Test

Before a new dish is added to the restaurant's menu, it's usually tested and refined.

Document

Just like a restaurant cookbook that contains recipes and instructions for each dish

Evolve

Restaurant menus, may need to evolve over time

How can we design data models?

The process: Step 1

Understand requirements

Understand the purpose and objectives: Theory of change

- Which is the objective of my intervention?
- What is the pathway of change?

Understand data requirements: MEAL plan

- Which is the indicators that help me monitor and evaluate?
- Which the the way of calculation?
- Which the the data source for the calculation? Which is the format?
- How will I use the information

Gather requirements from stakeholders: Data flow

- Who collects the information?And how often?
- Who access the information?And how often?
- Who analyzes the information? And how often?

Involve: MEAL staff, program staff while considering the experience from the field

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How can we design data models?

The process: Step 1

Project: Provision of social protection services to vulnerable population

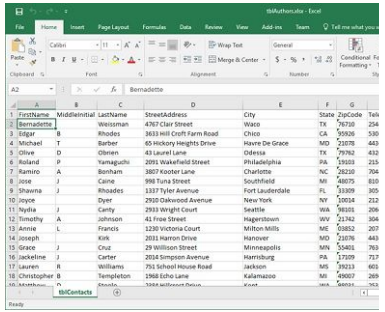
The project level MEAL plan lists multiples Means of Verification (MoVs) for the data collection

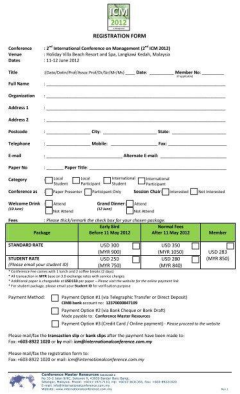
Challenges ahead in the absence of data model:

(1) Duplication of data, thus effort, thus cost
(2) Lack of data accessibility
(3) Unable to detect data inconsistency
(4) Unable to integrate with existing systems
(5) Risk of future reconstruction

PMP

OBJECTIVES STATEMENTS	INDICATORS	DATA COLLECTION				MEANS OF ANALYSIS		USE OF INFORMATION
		METHOD	FREQUENCY	PERSON RESPONSIBLE	RESPONDENTS	TYPE OF ANALYSIS	COMPARISON GROUPS	
STRATEGIC OBJECTIVE 1								
STRATEGIC OBJECTIVE 2								
INTERMEDIATE RESULT 1.1								
INTERMEDIATE RESULT 2.1								
OUTPUT 1.1.1								
OUTPUT 1.1.2								
KEY ASSUMPTIONS								
ASSUMPTION 1								
ASSUMPTION 2								





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How can we design data models?

The process: Step 2

Identify entities

Definition

Entity: a discrete data object, the basic building block of your database

What does this mean in practice?

The different data collection forms

Beneficiaries

GBV follow up form

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How can we design data models?

The process: Step 3

Identify attributes

Definition

Attribute: a characteristic that describes your entity in some way

What does this mean in practice?

The fields (actual questions) inside my data collection forms

Beneficiaries
• Name • Date of birth • Sex • Age • Family size

GBV follow up
• Date of follow up • Who performed the follow up? • Actions identified

How can we design data models?

The process: Step 4

Define relationships

Definition

How entities are associated amongst them?

What does this mean in practice?

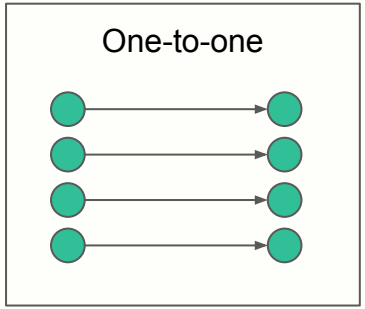
How can we describe the relationship between the records of the first table and the second table?

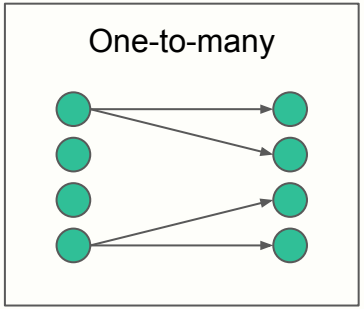
Beneficiaries
• Name • Bene ID • Date of birth • Sex • Age • Family size

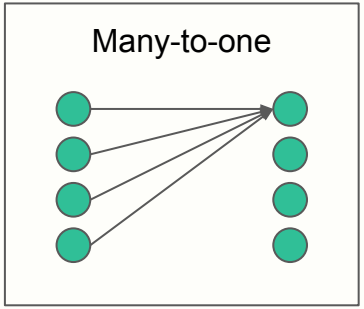
GBV follow up
• Date of follow up • Name of case worker • Actions identified • Session ID

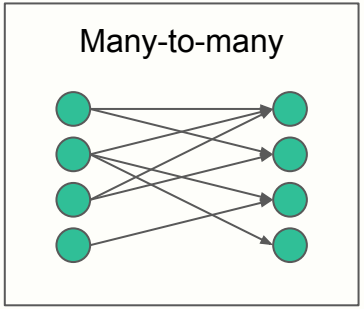
How can we design data models?

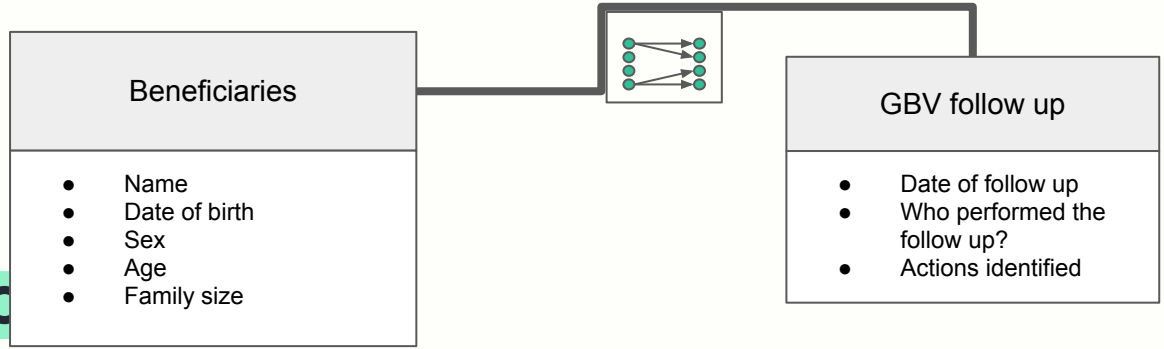
The process: Step 4











How can we design data models?

The process: Step 5

Reduce data duplication [Normalization]

Definition	the process of organizing your data in your database more efficiently, thus eliminating redundant data and improve data integrity
What does this mean in practice?	Data collections forms and their relationship should follow three main rules

Which are those rules?

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How can we design data models?

The process: Step 5

First Rule

Each attribute (column) in a table must contain only atomic (indivisible) values. This means that each cell of the table should hold a single, non-repeating value. Attributes should not contain lists, arrays, or nested structures (e.g age:30, contact (type:email, email:x/ type:number, number:y).

Name	GBV follow up dates
Eliza	18/02, 29/10
Maria	23/04,18/02, 29/10

Name	Bene ID	Session ID	GBV follow up dates
Eliza	01	02	18/02
Eliza	01	04	27/10
Maria	02	05	29/10
Maria	02	06	23/04

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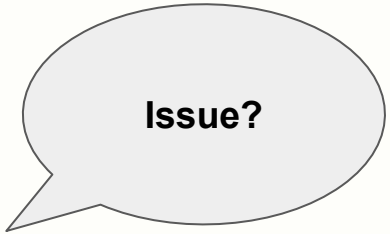
How can we design data models?

The process: Step 5

Second Rule

All other values must be functionally dependent on the whole primary key

Name	**Bene ID (partial Key)**	**Session ID (primary key)**	**GBV follow up dates**
Eliza	01	02	18/02
Eliza	01	04	27/10
Maria	02	05	29/10
Maria	02	06	23/04



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How can we design data models?

The process: Step 5

Second Rule

All other values must be functionally dependent on the whole primary key

Name	Bene ID (partial key)	Session ID (primary Key)	GBV follow up dates
Eliza	01	02	18/02
Eliza	01	04	27/10
Maria	02	05	29/10
Maria	02	06	23/04

Issue?

Session ID is the primary key and Beneficiary ID is partial key: Beneficiary name depends on Bene ID and not session ID

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How can we design data models?

The process: Step 5

Second Rule

All other values must be functionally dependent on the whole primary key

Name	Bene ID	Session ID	GBV follow up dates
Eliza	01	02	18/02
Eliza	01	04	27/10
Maria	02	05	29/10
Maria	02	06	23/04

Name	Bene ID (primary key)
Eliza	01
Maria	02

Bene ID	Session ID (primary key)	GBV follow up dates
01	02	18/02
01	04	27/10
02	05	29/10
02	06	23/04

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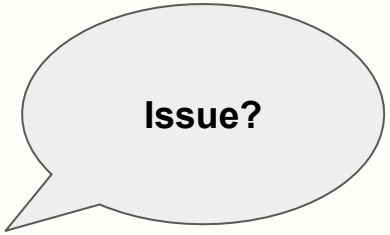
How can we design data models?

The process: Step 5

Third Rule

It should not have any transitive dependencies. A transitive dependency occurs when a non-key attribute depends on another non-key attribute, rather than directly on the primary key.

Name	Bene ID	Session ID	SW ID	GBV follow up dates
Eliza	01	02	001	18/02
Eliza	01	04	001	27/10
Maria	02	05	003	29/10
Maria	02	06	003	23/04



How can we design data models?

The process: Step 5

Third Rule

It should not have any transitive dependencies. A transitive dependency occurs when a non-key attribute depends on another non-key attribute, rather than directly on the primary key.

Name	Bene ID	Session ID	SW ID	GBV follow up dates
Eliza	01	02	001	18/02
Eliza	01	04	001	27/10
Maria	02	05	003	29/10
Maria	02	06	003	23/04

Issue?

SW ID is not a key and SW depends on Name of the beneficiary, which is not a key - **the table DOES not have clear purpose**

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How can we design data models?

The process: Step 5

Third Rule

It should not have any transitive dependencies. A transitive dependency occurs when a non-key attribute depends on another non-key attribute, rather than directly on the primary key.

Name	**Bene ID (primary key)**
Eliza	01
Maria	02

SW ID	**Bene ID (primary key)**
001	01
002	02

Bene ID	**Session ID (primary key)**	**GBV follow up dates**
01	02	18/02
01	04	27/10
02	05	29/10
02	06	23/04

How can we design data models?

The process: Step 6

Visualize, Test, Document and Evolve

Create a visual representation of your data model which can help you and your team visualize the structure and relationships.

- Test your data model to ensure it meets the defined requirements and constraints.
- Validate that it can handle expected data volumes and access patterns.

- Create comprehensive documentation that describes the data model.
- Good documentation is crucial for team communication and maintenance.

Consider program changes and field staff feedback that may results in maintenance, data model evolution.

Involve:
Field staff, leave time for testing and consider actively their feedback. Consider the reports and involve MEAL staff or data analysts

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How can we design data models?

Key Messages

- The complexity of social issues make imperative the need for a clear data model.
- Consider always your starting point. The Theory of change, MEAL plan and the data flow define requirements.
- Create data collection with clear objectives. This will help you comply with the normalization rules.
- Visualize always the data model.
- Involve relevant stakeholders in the design process, testing and documentation.

How can we design data models?

Glossary

Entity: a discrete data object, the basic building block of your database

Attribute: a characteristic that describes your entity in some way

Relationship: how entities relate to each other

Cardinality: how many on one side of the relationship relate to how many on the other side of the relationship

Key: an attribute or combination of attributes used to uniquely identify an entity

Normalization: the process of organizing your data in your database more efficiently

Data modelling best practices

Creating data models that facilitate analysis

The evolution of data models

How data model can facilitate analysis?

Hierarchical database model

-Organizes data in a tree structure.with a one-to-many relationship between records

-Each parent record has one or more child records.

-Resembles the structure of a file system.

Network database model

-Similar to a hierarchical database but with a many-to-many relationship between records.

-Records can have multiple connections, not just a one-to-many structure.

Relational database model

-Clearly defined entities are responsible for holding, organizing, storing, retrieving, and accessing data

-Clearly defined actions enable applications to manipulate the data and structures of a database.

-Integrity rules govern operations on the data and structures of a database.

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Source: Introduction to Database by Oracle

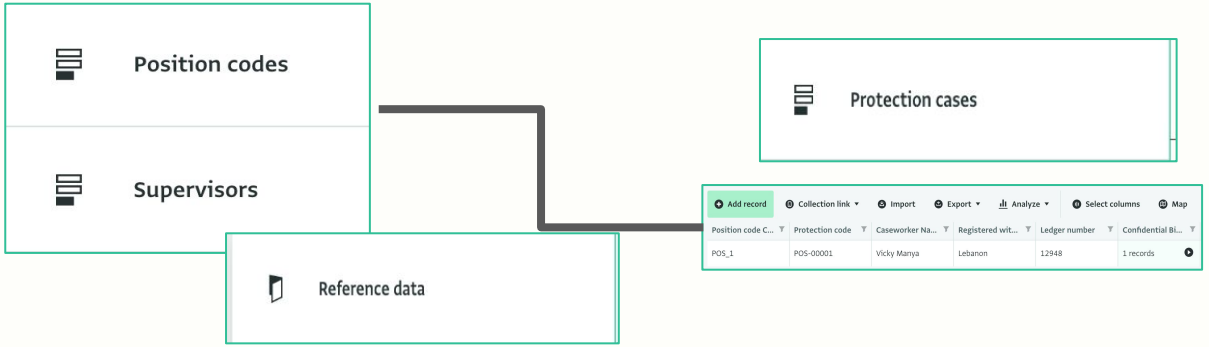
Common relational models in Humanitarian and Development practice

Protection," "Child Protection," and "Gender-Based Violence (GBV)

Organization: it's organized around individual cases or beneficiaries in a humanitarian context. It includes fields for personal details, assistance provided, location, and case status.

Rationale: In humanitarian development, this data model helps organizations and agencies manage and track assistance and support provided to individuals or communities affected by disasters, conflicts, or other crises. It enables efficient allocation of resources and ensures accountability for aid delivery.

Level 1: Identify the data collection forms



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Example: [ActivityInfo Case management database template for Protection]

Creating data models that facilitate analysis

Level 2: define relationships

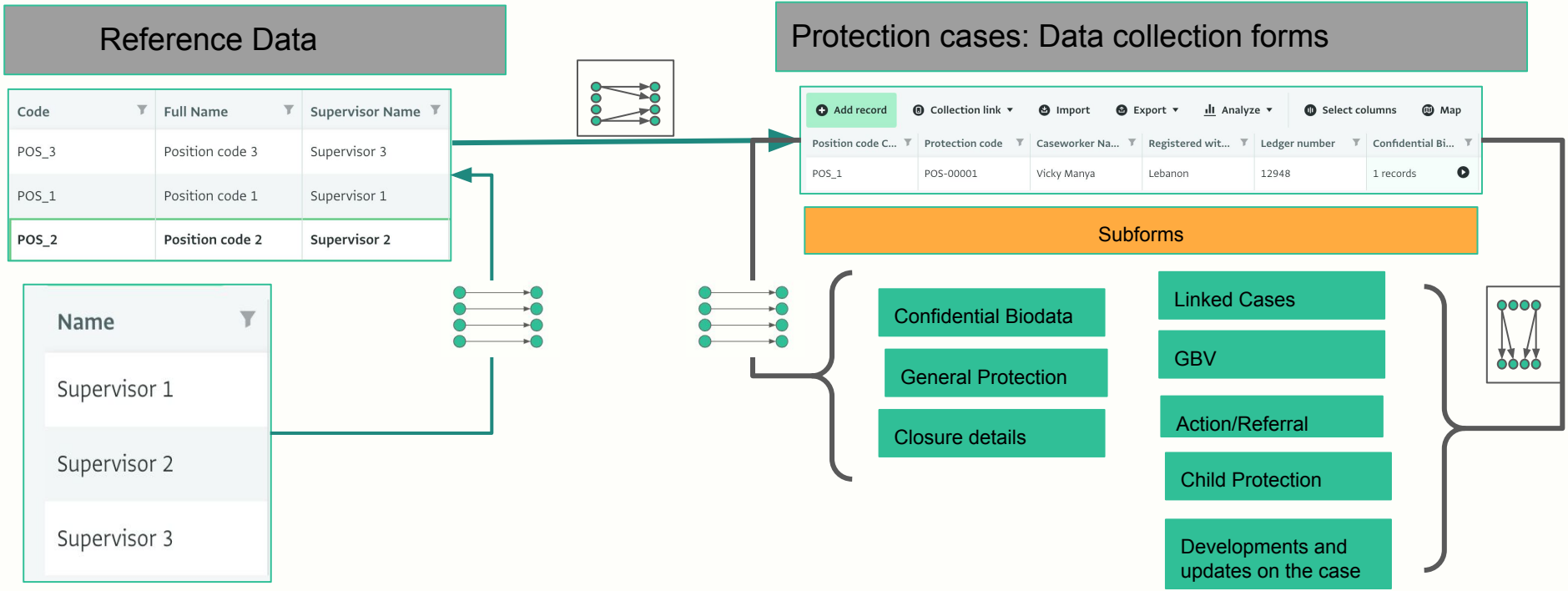

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Table definition and association supports flexibility,efficient user role definition, ability to edit, export and import data

Example: ActivityInfo Case management database template for Protection

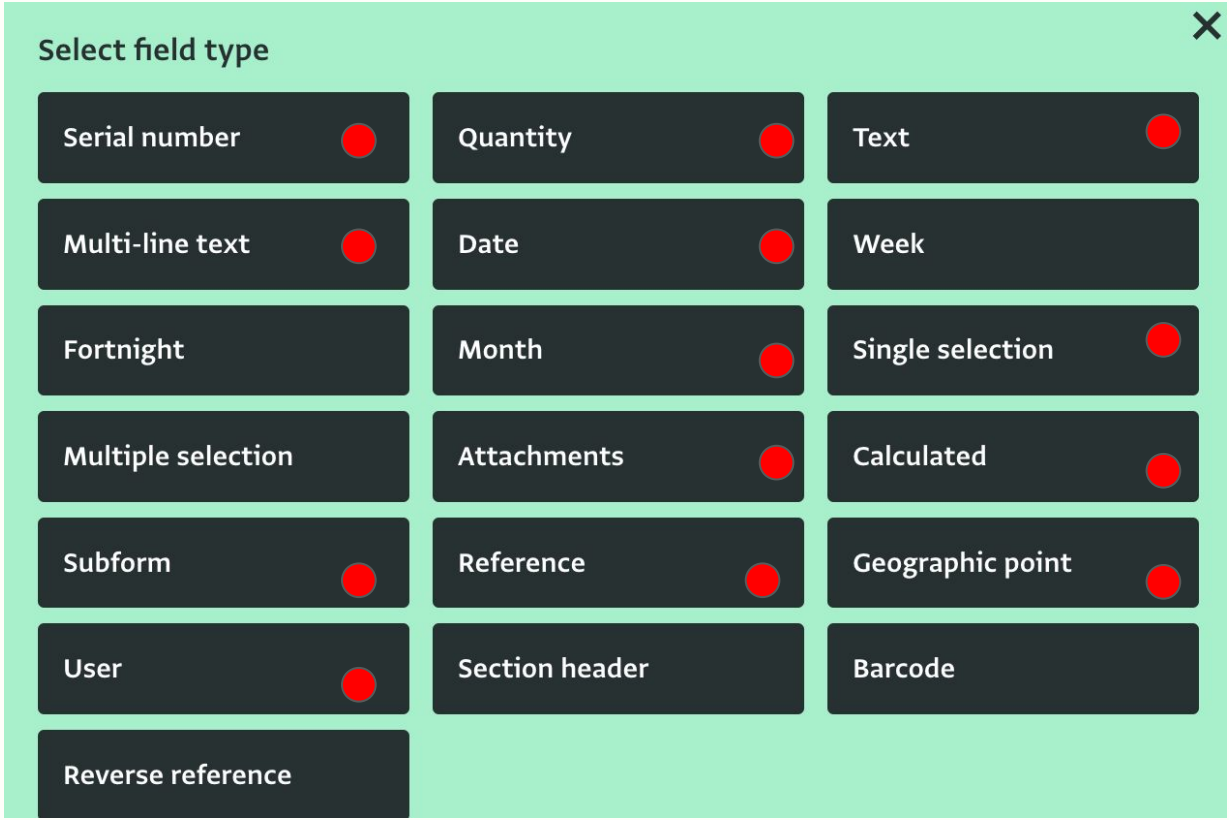
Creating data models that facilitate analysis

Level 3: define fields (attributes) and establish constraints

Relational databases are flexible

- Can handle various types of data, making them suitable for a wide range of use cases
- Improve data consistency

Used in the template



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Creating data models that facilitate analysis

Key components that make the data model efficient: Summary

Tables and Subforms	The database utilizes tables and subforms to organize and store data related to cases.It is designed to minimize data redundancy and improve data integrity through normalization.
Relationships	The database uses reference forms to link related information. Referential integrity, or the ability to maintain data consistency through referencing, is a key feature of relational databases.Primary and Foreign keys like names, serial numbers, position codes and supervisors names etc aid this relationship
Flexibility	Architecture is flexible and can handle various types of data, making them suitable for a wide range of cases. The ability to customize forms and fields aid flexibility
User Roles	This role-based access control is a common feature in relational databases to restrict access and manage permissions.
Data Entry and Editing	Users can easily add, edit, and update records in the database.
Integrity constraints	The use of relevance and validation rules as unique and check constraints, ensuring that the data is accurate and consistent.
Import and Export	Which allows us connect to other platforms either through API integration or just the use interface that allows data export and import.

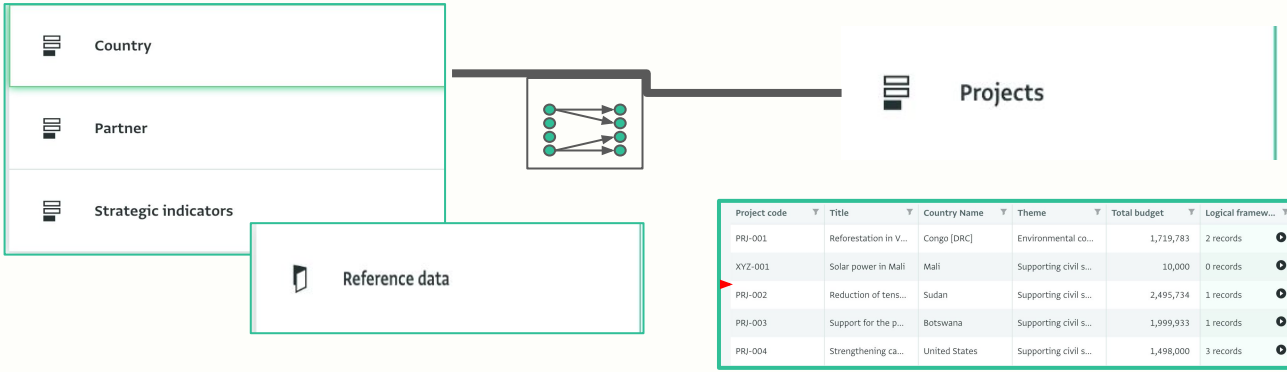
Common relational models in Humanitarian and development practice: More examples

Programme Monitoring and Evaluation (M&E) Tracking Development Data Model

Organization: This data model focuses on monitoring and evaluating humanitarian programs and projects. It includes data related to the goals, objectives, beneficiaries, project locations, and impact indicators.

Rationale: Humanitarian organizations need to assess the effectiveness of their interventions during crises. The M&E data model for humanitarian development helps collect and analyze data to ensure that aid programs are meeting their objectives and making a positive impact on affected populations.

Level 1: Identify the data collection forms and relationships



Example: **Indicators Tracking with Global M&E database template**

Best practices

Change Management During Digital Transformation in M&E Teams

Barriers to Digital Transformation	Enablers for Digital Transformation
Data Security Concerns	Internal Advocates
Data Confidentiality Concerns	Ease of Use
Reluctance to Leave Comfort Zone	Data Security Assurances
	Open Communication
	Support Teams

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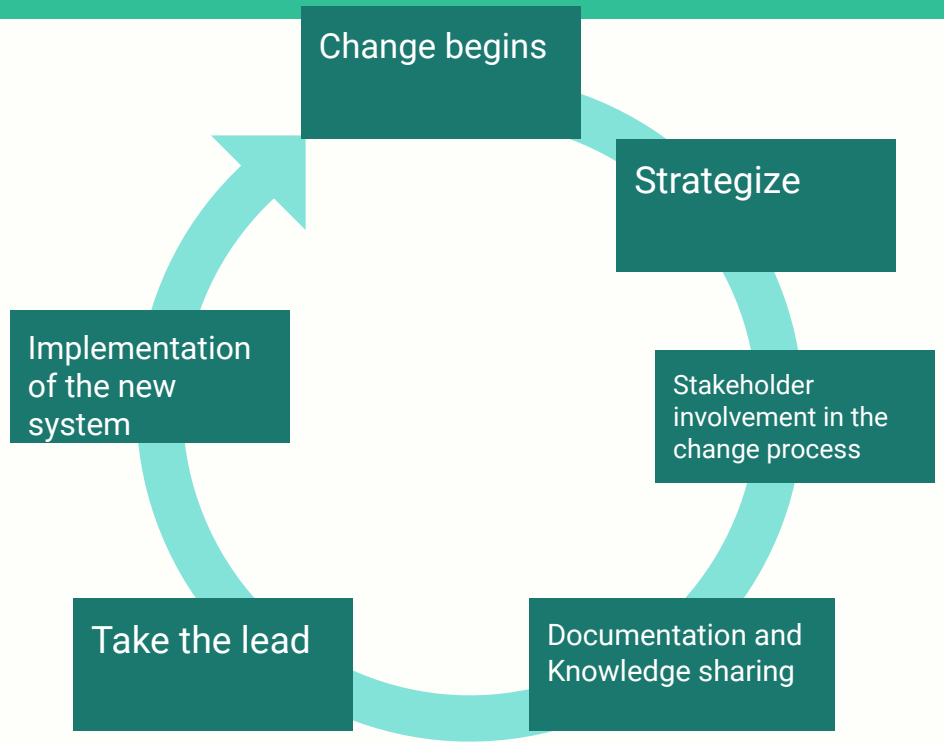
Best practices

Change Management framework for M&E Teams



What does a change mgt process look like?

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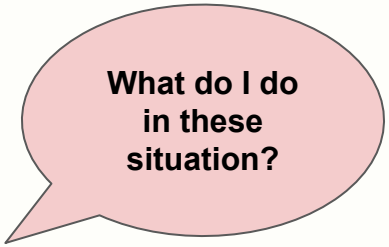
Questions and answers between facilitators



1. Do I need different forms if I work with different partners on the field?
2. Do I need a different data collection form for each indicator in an M&E tracking data model?
3. In my needs assessment, I need to perform score calculation? How can I do it within activityInfo?

Q&A