

Multi-Agent Based Environment for Decision Support and Optimisation Modelling

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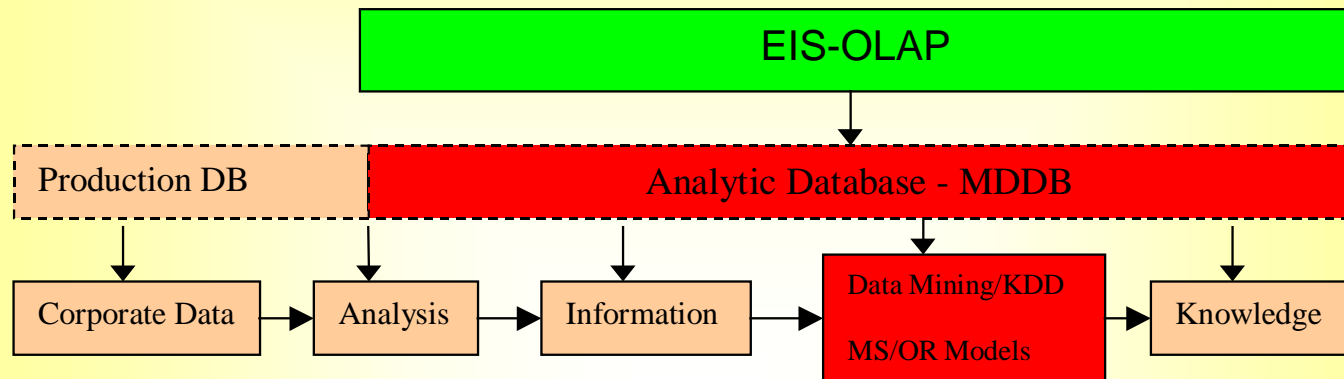
Outline

- IS / DSS : An overview
 - EIS / DSS Tools
 - A Critique
 - Agents / Benefits
 - Summary Architecture
- Intelligent Autonomous Agents (IAA)
 - What are IAAs
 - Agent Communication / Agency
 - Inside an Agent

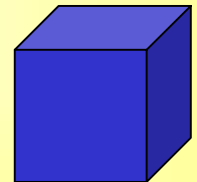
Outline

- Optimisation Modelling
 - Modelling Steps
 - An Example
 - Relative Positioning of Tools
- Agent-Based Optimisation Environment
 - An Evolutionary Architecture
 - Examples...
- Discussion

EIS / DSS Tools



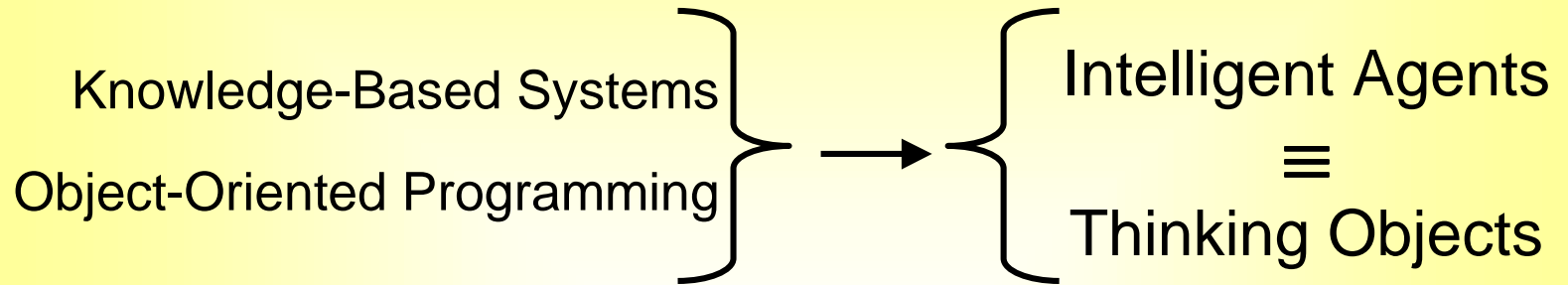
- On Line Analytical Processing (OLAP)
- Data Warehouse
- Multidimensional Database
- Multidimensional Views → DataCubes



A Critique

- Graphical User Interface (GUI) or Intelligent User Interface (IUI) ?
- Multi-User...Multiple Requirements...Multiple Platforms...Distributed...Workgroup Computing
- Elicitation of User Requirements
 - Data ... Model ... Structure ... Results
- Information Explosion / Sifting...Extraction
 - Smart Decision Making

Intelligent Autonomous Agents (IAAs)



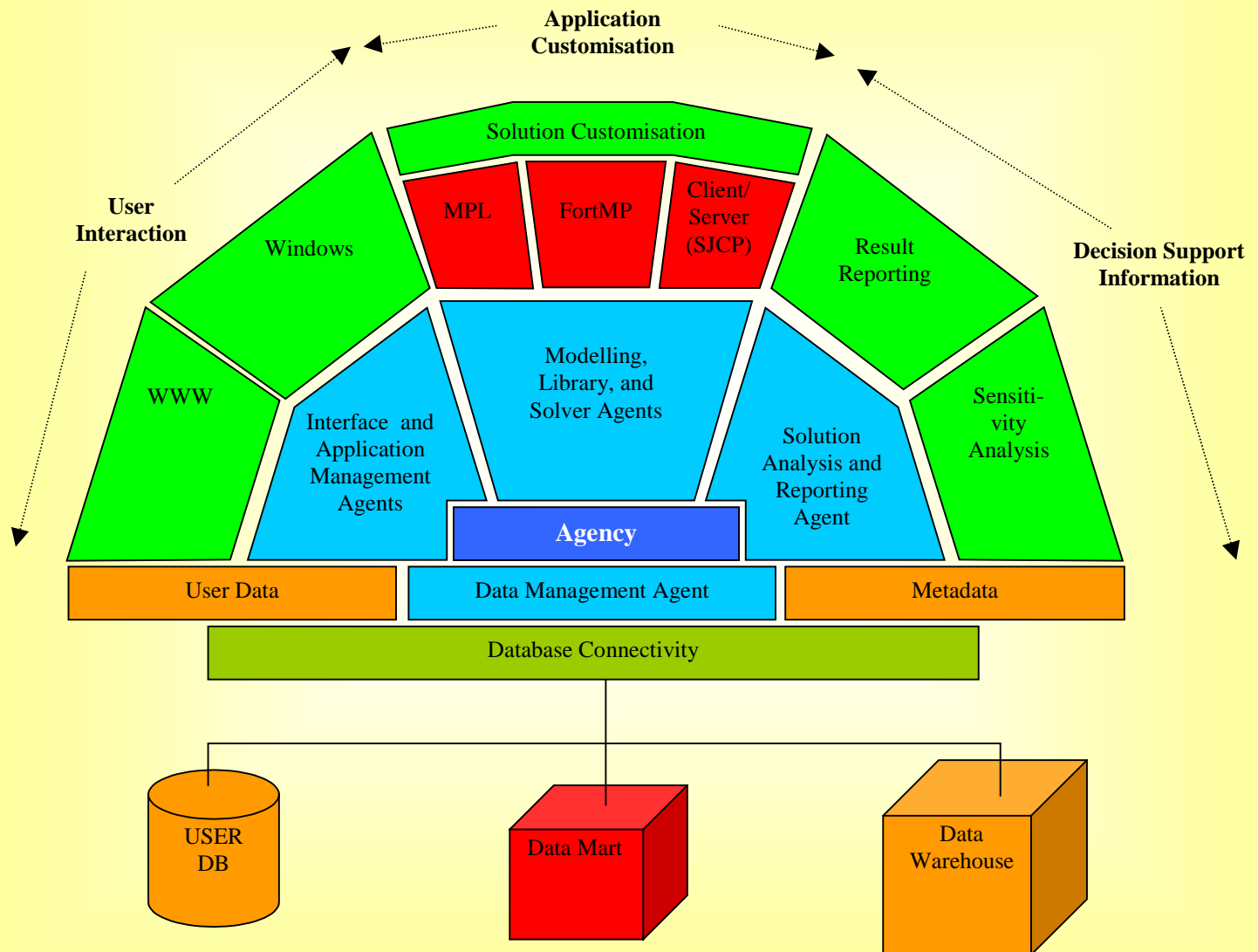
- Autonomous, Purposeful Activity
Context / Task Specific
 - Autonomy
 - Social Ability
 - Responsiveness
 - Proactiveness
- Belief ... Desire ... Intention (Goal Seeking)

Agents / Benefits

- IUIs
- Elicitate Model
- Support Workgroups
- Results Filtering

General Trend ... Tools to Agents

An Evolutionary Architecture

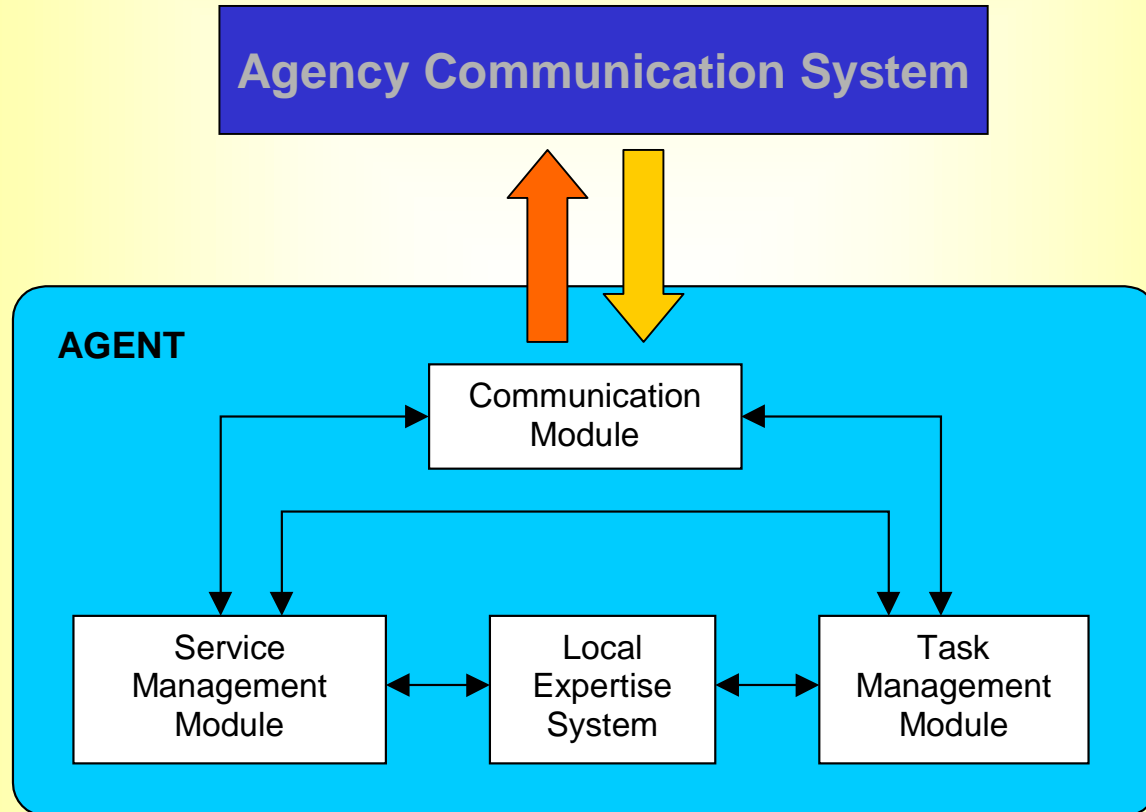


Agents Revisited

An autonomous agent ..within an environment
..senses ..acts in pursuit of its own agenda...

- Agent Types
 - Interface Agents
 - Service Agents
- Agents Collaborate with human .. Other Agents
- Multiple Agents.. Collaboration .. Agency..
Architecture

Inside an Agent



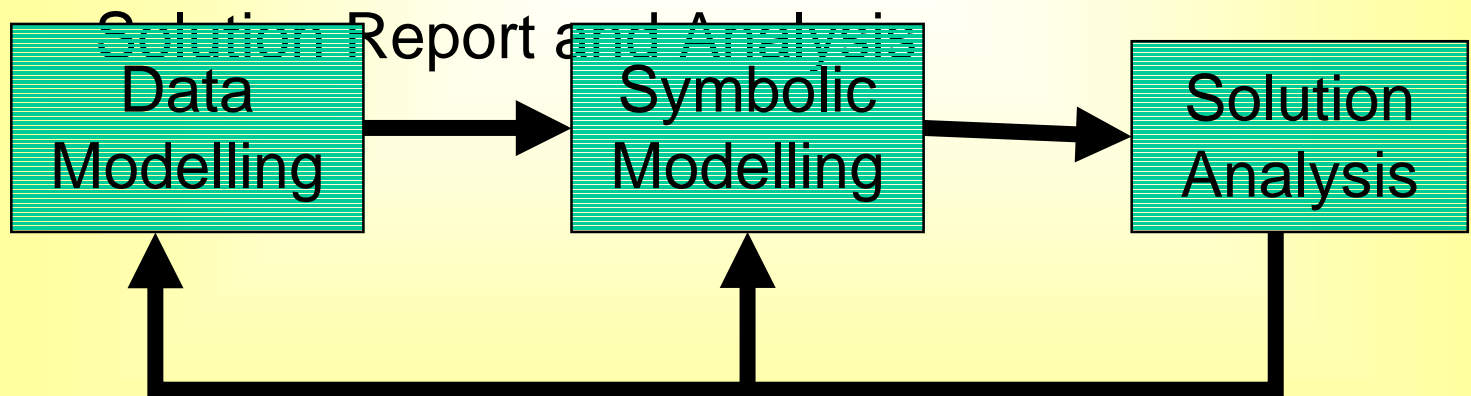
Optimisation Modelling

Sets...Data Tables... Variables....Constraints

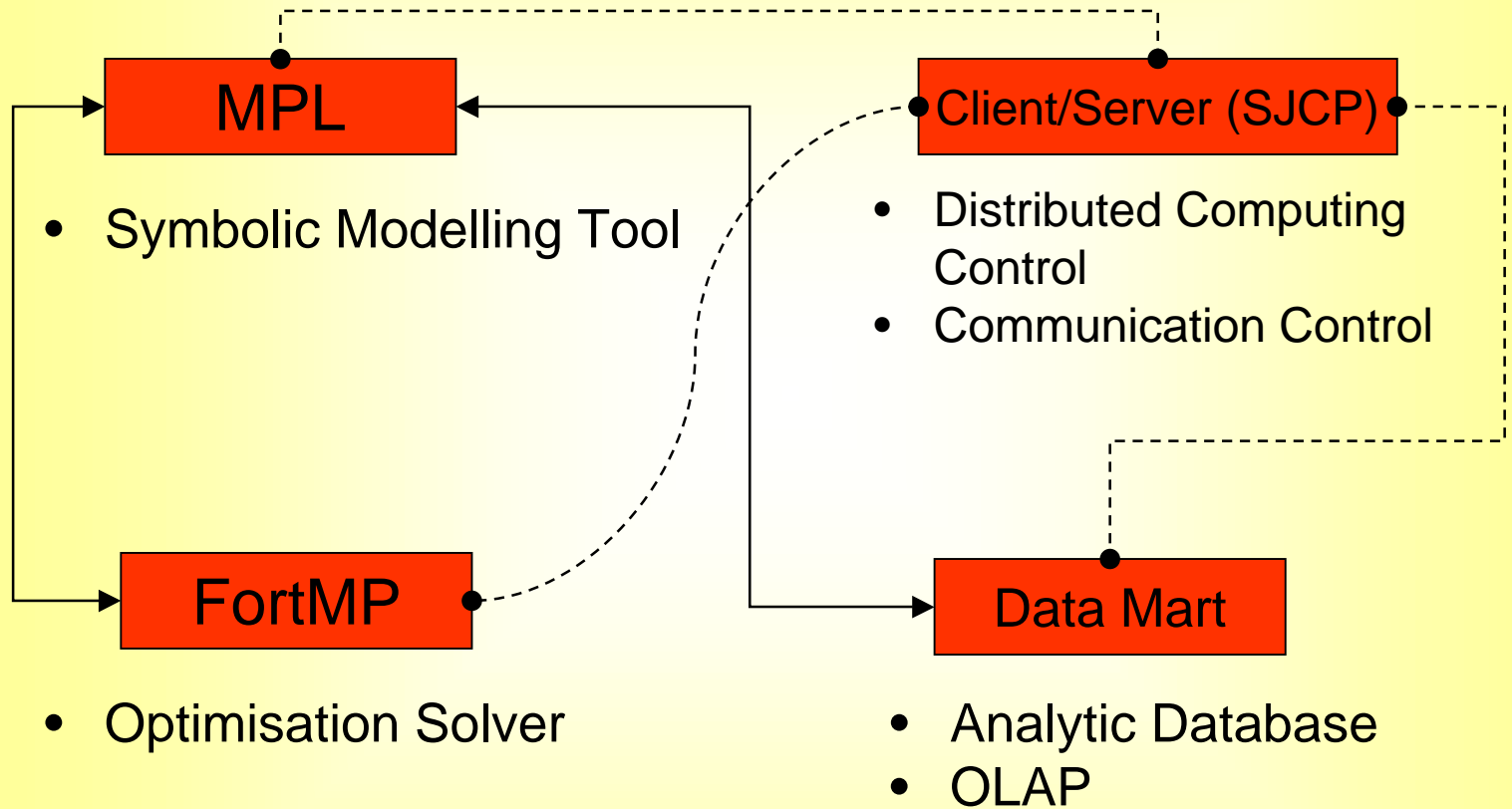
Elicitation Process

Categorisation and Data Modelling

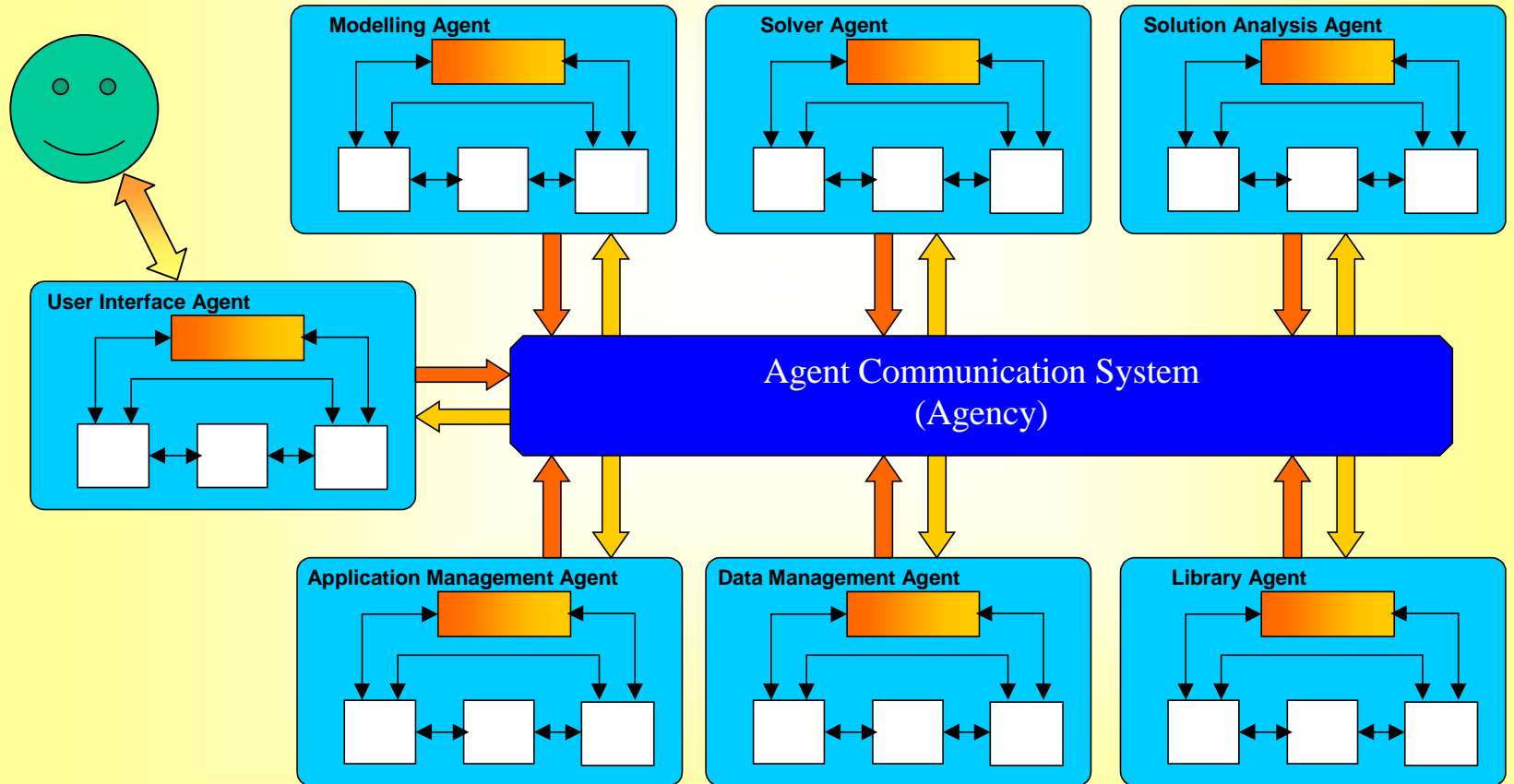
Symbolic Modelling



Relative Positioning of Tools



The Architecture



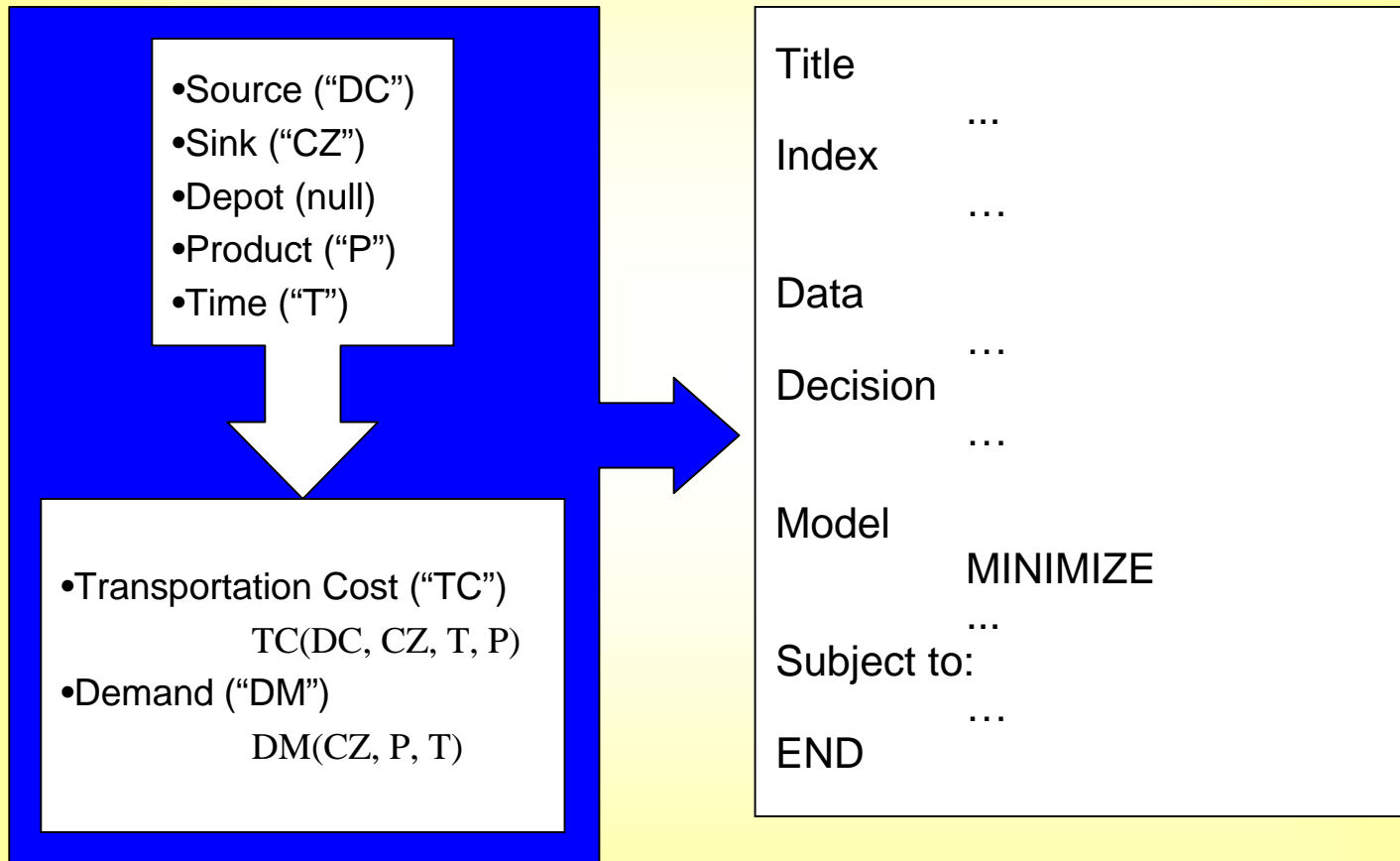
An Example

Supply Chain Logistics Example:

A company distributes a number of **products (P)** to a number of **customer zones (CZ)**. The company wishes to decide when, where, and of what size **distribution centres (DC)** to install in order to satisfy customer **demand** for a certain number of **time periods (T)** into the future. In addition the **transportation process** should be optimised in order to minimise **costs**. There are a number of distribution centres currently in operation and a number of distribution centres that can become operational if required at certain

Example 1: Library Agent

- Supply Chain Logistics Template:



- Modification...

Example 2: Modelling Agent

Dimension Consistency:

```
ExistShip(ExSite, Cust, Prod, Time) +  
NewShip(NewSite, Cust, Prod, Time) +  
Shortage(Cust, Prod, Time) >= Demand(Cust, Prod, Time)
```

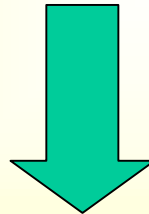


```
Sum(ExSite: ExistShip(ExSite, Cust, Prod, Time)) +  
Sum(NewSite: NewShip(NewSite, Cust, Prod, Time)) +  
Shortage(Cust, Prod, Time) >= Demand(Cust, Prod, Time)
```

Example 2 Continued...

Unit Consistency:

```
ExCapacity Unit in Tons
ExistShip Unit in Kg
.....
.....
Sum(Prod,Cust:ExistShip(ExSite,Cust,Prod,Time)
    <= ExCapacity(ExSite,Time)
```



```
Sum(Prod,Cust:ExistShip(ExSite,Cust,Prod,Time)
    <= ExCapacity(ExSite,Time)*1000
```

Example 3: Solver Agent

Model Type: Supply Chain Logistics

Recommended Algorithm and Parameters

IPM

Crossover

...

MIP ON

...

Example 4: Solution Analysis

Reports:

...

...

Fact:

Customer **CUST=C1** demand in time period **TIME=T2**
is in shortage by **Shortage(Cust,Prod,time)=400**

Analysis:

- or
- All sites are functioning at full capacity
 - Unit transportation cost is more than unit shortage cost

...

Example 4 Continued

Logical Analysis

...

...

Model Verification:

Customer **Cust=C2** is receiving goods from Site **ExSite=S5** in time period **TIME=T3** but site **ExSite=S5** is not open in **TIME=T3**.

...

...

Discussion

- Tools to Agents
- Evolutionary & Autonomous
- Distributed Workgroup Computing
- Relevant to EIS/DSS