

TUTORIAL – SESSION 4 IMPLEMENTATION OF THE VRP PROBLEM (VEHICLE ROUTING PROBLEM)



**SEMINARIO:
TECNICAS AVANZADAS DE OPTIMIZACIÓN PARA EL SECTOR PETROLERO**

PROMOTERS:



PARTICIPANTS:



Invited Speaker:

Professor Ignacio Grossmann, Ph. D.
Center for Advanced Processes Decision-making (CAPD)
Carnegie Mellon University

Date: Friday February 5th, 2016
Time: 9:00 am a 5:00 pm
Place: Auditorio PEMEX, México D.F.
Attendance: Personal invitation

Ask for invitation:



Detailed programm:



OPTIMIZATION SOLUTIONS FOR OIL & GAS



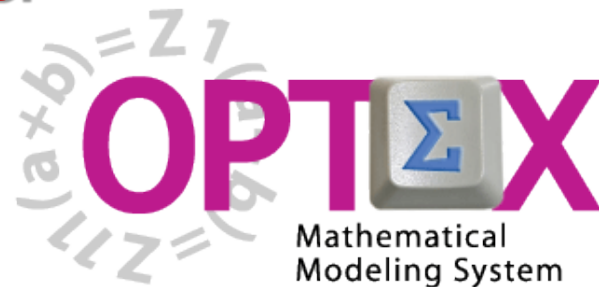
Strategic	Decision Horizon	<ul style="list-style-type: none"> Project & Budget Planning Staff Budgeting Inventory Budgeting and Positioning Delivery Planning Maintenance Planning Network Design and Sourcing 	<ul style="list-style-type: none"> Pipeline Network Design Sourcing Rail Fleet Sizing Vessel Fleet Sizing Long Term Purchasing 	<ul style="list-style-type: none"> Plant Sizing and Sourcing Long Term Production Planning Purchase & Storage Planning 	<ul style="list-style-type: none"> Pipeline Network Design Sourcing Rail Fleet Sizing Vessel Fleet Sizing
	Years				
	Months				
Tactical	Quarters	<ul style="list-style-type: none"> Project Planning Maintenance Scheduling Technician Planning Production Planning Trading and Risk Management Oil Blending 	<ul style="list-style-type: none"> Vessel Planning Rail Planning Empty Car Management Spot Cargo Management Trading 	<ul style="list-style-type: none"> Production Planning Inventory Planning 	<ul style="list-style-type: none"> Distribution Planning (vessel, rail, truck)
	Months				
	Weeks				
Operational	Days	<ul style="list-style-type: none"> Project Scheduling, Monitoring and Rescheduling Technician Dispatching Inventory Assignment Resources Allocation 	<ul style="list-style-type: none"> Berth Allocation Pipeline Scheduling Vessel Scheduling Rail Scheduling Staff Scheduling 	<ul style="list-style-type: none"> Refinery Planning and Blending Scheduling Production and Outbound Logistic Scheduling Pipeline Scheduling 	<ul style="list-style-type: none"> Berth Allocation Vessel Scheduling Rail Scheduling Truck Routing Vendor Management Inventory
	Hours				
	Minutes				

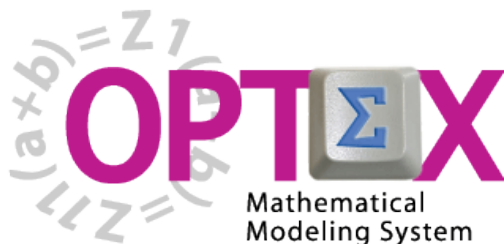
Source: IBM



DOA invited you to visit <http://ifors.org/icord2016/> and to participate in ICORD 2016 that will be held on June 9-10, 2016 at the facilities of Instituto Tecnológico Autónomo de México (ITAM) in México City.

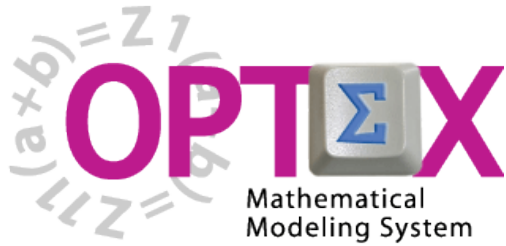
SPONSORS:





BASIC TUTORIAL

1. **SESSION 1: INTRODUCTION**
 - Introduction to OPTEX (Section 1)
 - OPTEX-EXCEL-MMS (Section 2)
2. **SESSION 2: VRP MODELING IN EXCEL**
 - VRP: Vehicle Routing Problem (Section 3)
 - Implementing VRP Model using EXCEL (Section 4)
3. **SESSION 3: USING EXCEL TO LOAD DATA**
 - Industrial Data Information Systems –IDIS- (Section 5)
4. **SESSION 4: OPTEX-GUI – LOADING MODELS**
 - Loading the Model in OPTEX-MMIS (Section 6)
 - Verification of the Model in OPTEX-MMIS (Section 7)
5. **SESSION 5: Loading and Checking Industrial Data**
 - Implementation and Validation of IDIS- (Section 8)
6. **SESSION 6: Solving Mathematical Models**
 - Scenarios and Families of Scenarios (Section 9)
 - Solution of Mathematical Problems (Section 10)
 - Results Information System (Section 11)
7. **SESSION 7: SQL Servers**
 - Using SQL Servers for IDIS (Section 12)
8. **SESSION 8: Optimization Technologies**
 - Solving Problems using C (Section 13.1)
 - Solving Problems using GAMS (Section 13.2)
 - Solving Problems using IBM OPL (Section 13.3)



TUTORIAL IMPLEMENTATION OF THE VRP PROBLEM (VEHICLE ROUTING PROBLEM)

BASIC TUTORIAL

- ### 4. SESSION 4: OPTEX-GUI – LOADING MODELS
- Loading the Model in OPTEX-MMIS (Section 6)
 - Verification of the Model in OPTEX-MMIS (Section 7)

This session is oriented to the user that has **OPTEX** installed in his PC.

LOAD OF MODEL AT OPTEX-MMIS

Below, it is analyzed the process of loading the VRP model into the **Information System of Mathematical Models** of **OPTEX (OPTEX-MMIS)**, so the user must have installed OPTEX on his computer.

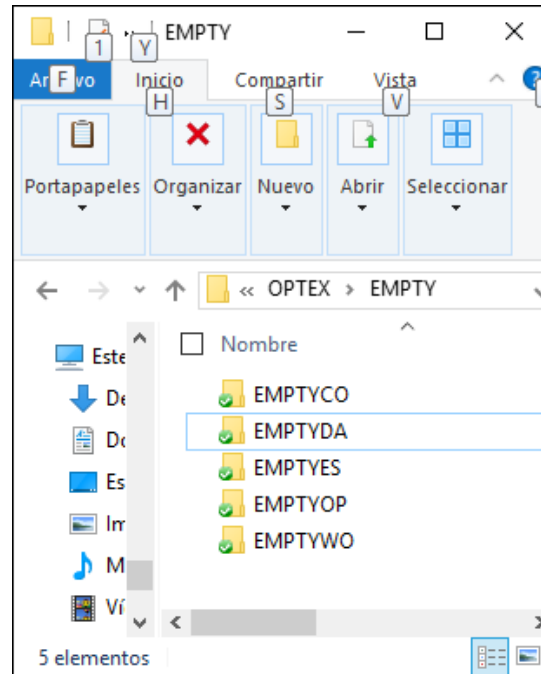
The process of loading the existing information in the EXCEL to OPTEX-MMIS template can be in multiple ways:

- **Manually:** in this case the user loads each table stored in EXCEL, to do this creates tables in CSV format, eliminating the second row, and imports them to OPTEX-MMIS.
- **Automatically:** in this case used a service from OPTEX that allows to import all tables from the book with a single click.

Given the didactic nature of this document, the first method should be used in a way such that the user becomes familiar with the different windows of work and the services offered by OPTEX in each of them.

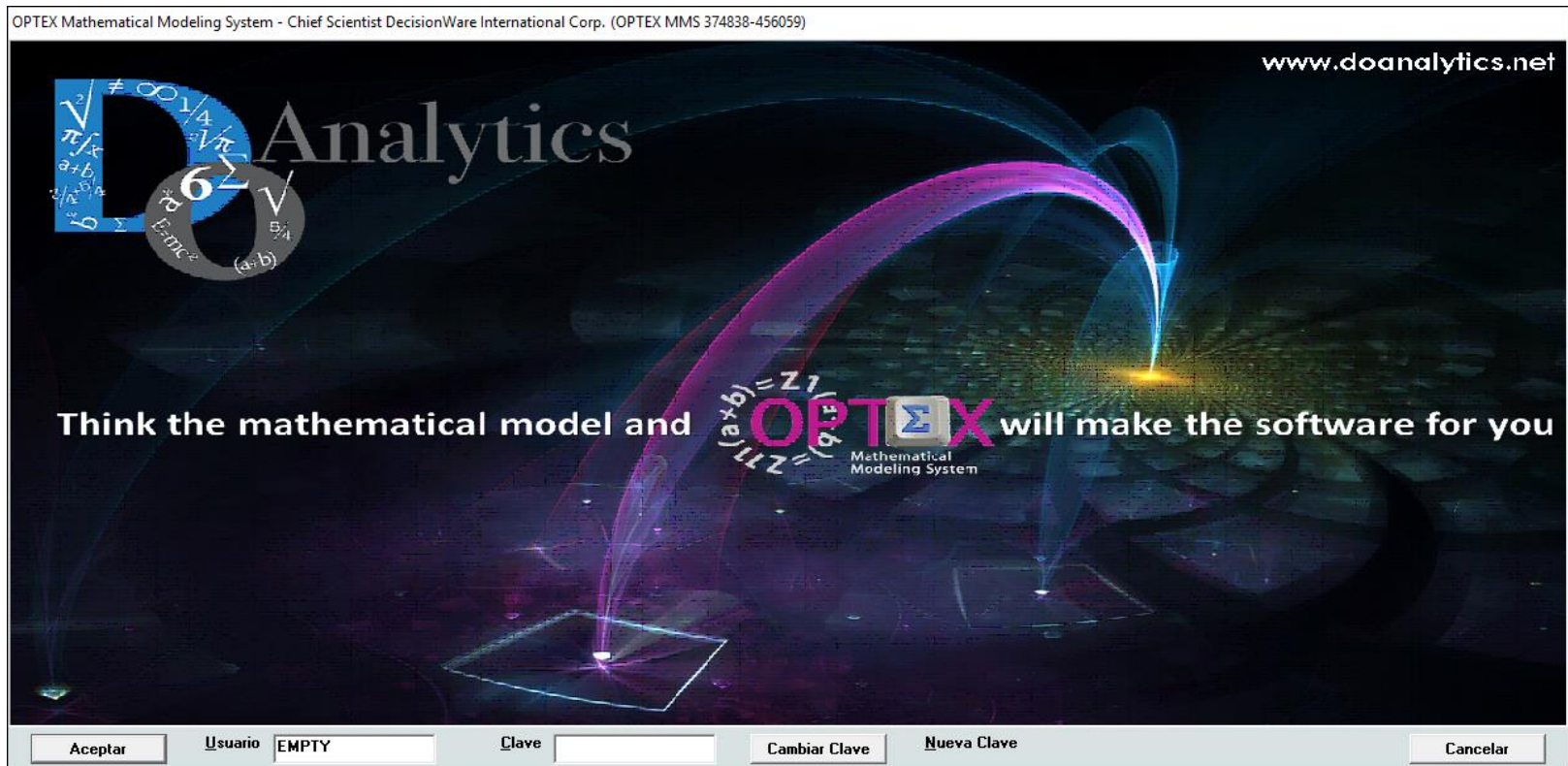
ACCESS TO OPTEX-GUI

An **OPTEX** application called **EMPTY**, which can be used to load the VRP model in **OPTEX**, was included in the installation process of **OPTEX**.



ACCESS TO OPTEX-GUI

To access such application should be login to OPTEX-GUI under the **EMPTY** user name. The user must activate the program **OPTEX_GraphicsUsersInterface.EXE**, located in the directory **/BIN/**.

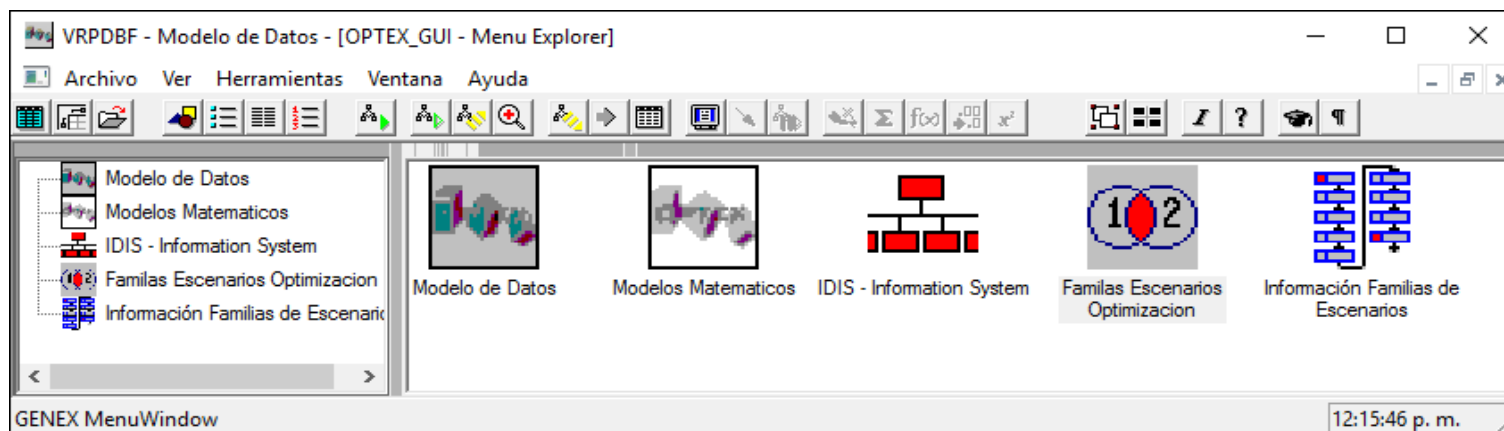


WORKING IN OPTEX-GUI

The login process will give the user access to a browser window of OPTEX from which you will have access to exploration of OPTEX-GUI menu, from there you can access the menu of exploration of mathematical models and data model menu, which give access to the tables that handle the corresponding to those existing in the EXCEL workbook. The load of elements at OPTEX-MMIS will be following the same order of loading of EXCEL tables.

OPTEX-GUI allows access to the four areas of application data:

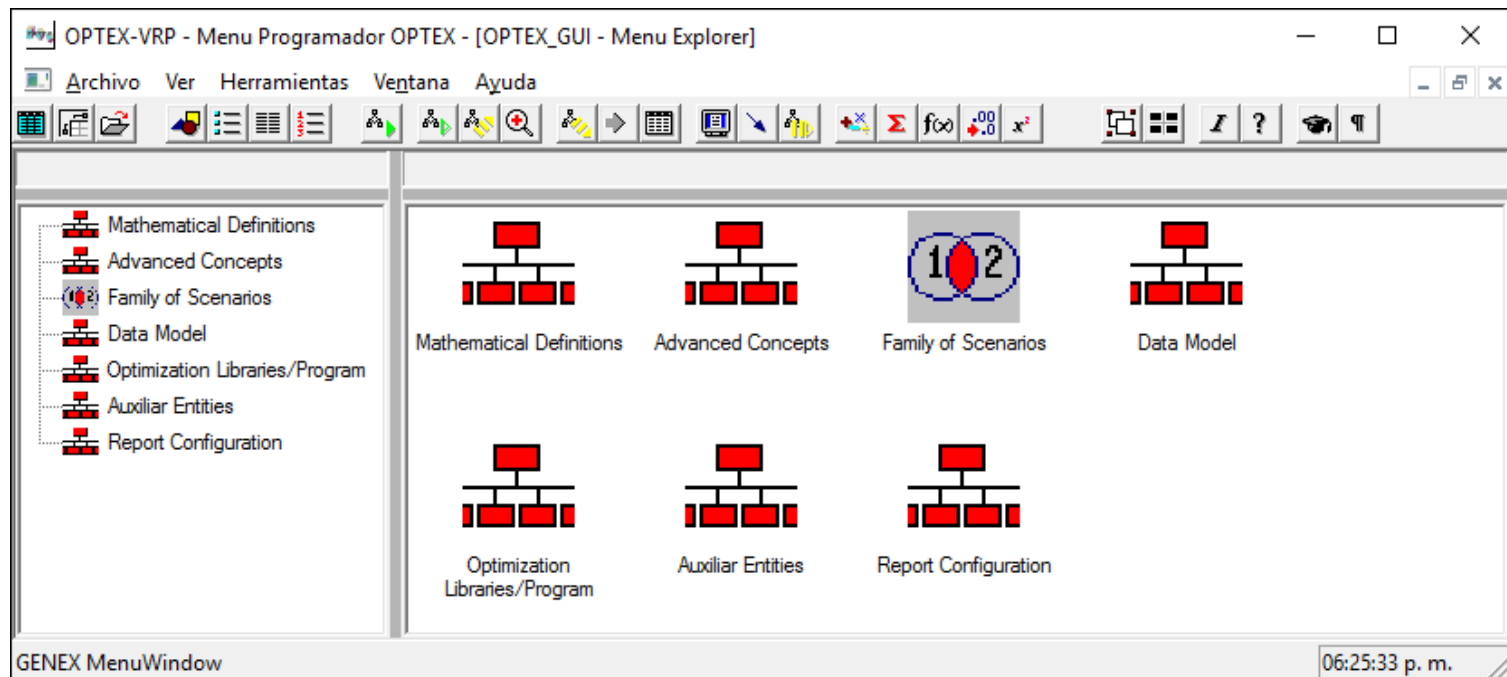
- **Data Model**
- **Mathematical models**
- **Permanent Industrial System**
- **Scenarios of Industrial System**



WORKING IN OPTEX-GUI

The load of model the user must access to the so-called **Mathematical Models** area, where you can access the tables associated with mathematical models and the tables associated to the data model, working in three sub-areas:

- **Mathematical Models**
 - **Mathematical Definitions**
 - **Advanced Concepts**
- **Data Model.**



WORKING IN OPTeX-GUI

IMPORTANT

The reader must take into account that by default OPTeX works using tables in DBase format, and that it is therefore convenient to understand management given to this type of table, explained in section 1 of the present document.

Additionally, for importing data should be aware that the process is slightly different for master tables and for secondary tables. You can import master tables without problem from any shell/container window that is related to the master table as main table; for the secondary tables they must be access from shell window that have as main data window the secondary table.

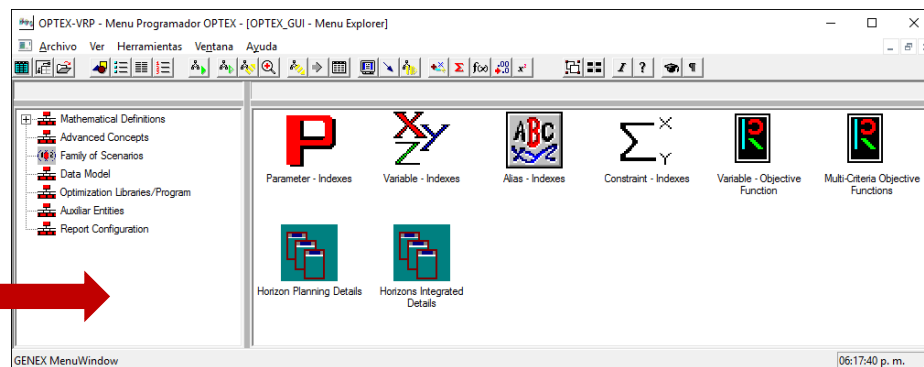
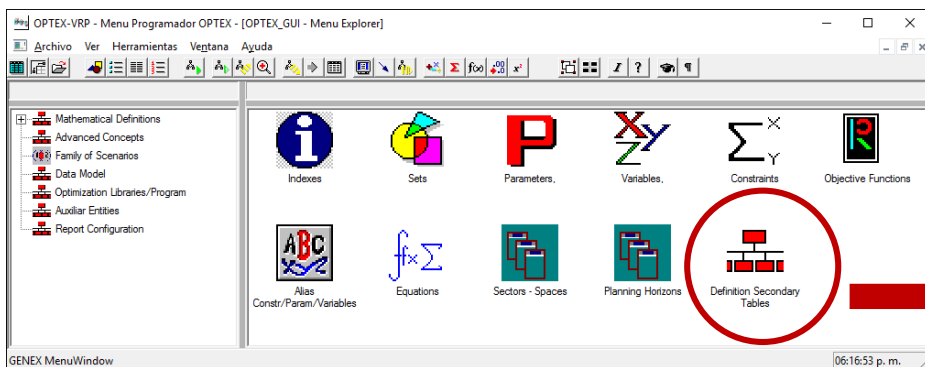
Therefore, a secondary table CAN NOT be imported from a window container that has as main data window a master window; this failure is due to secondary tables, that are opened from a master table, have filters that reject records that do not comply with this filter. To handle this situation, it is available at OPTeX of menus that give you direct access to secondary tables, so that the user makes use them when convenient.

LOADING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS)

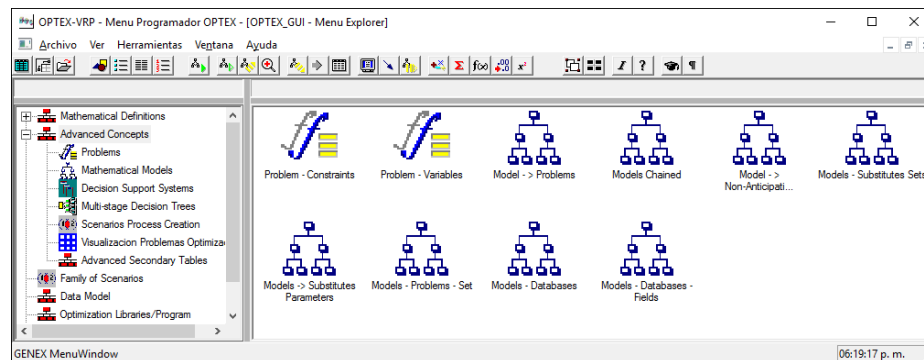
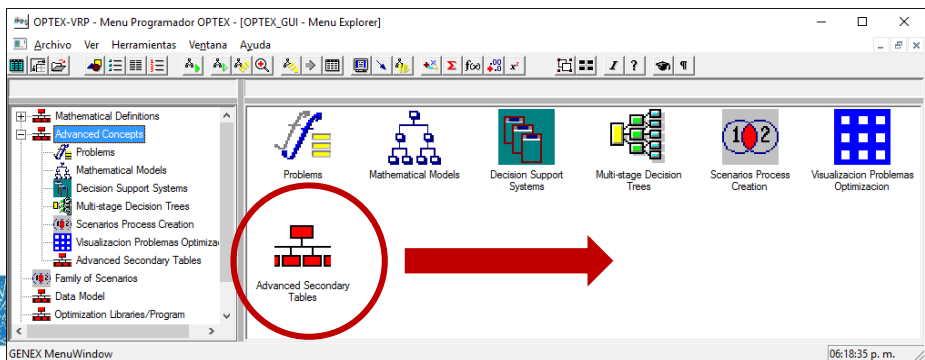
To load the **tables related to the mathematical models** the user should access the corresponding menus which are displayed in the following images.

The menus on the left correspond to accesses to the **master tables of mathematical elements/objects**, and those on the right to access to **secondary tables**.

MATHEMATICAL DEFINITIONS



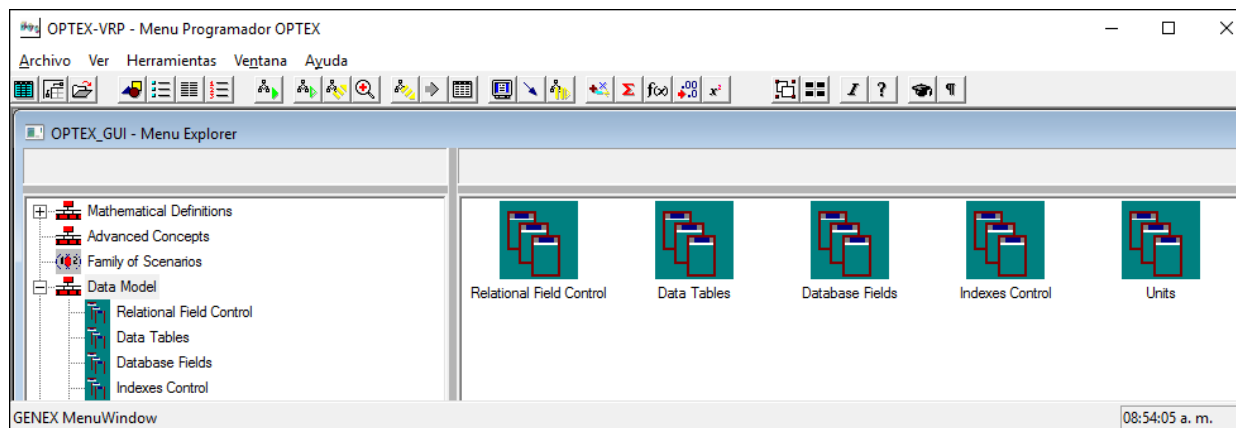
ADVANCED CONCEPTS



LOADING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS)

In the case of **tables associated with the data model**, all tables, master and secondary, they are accessed from the same menu.

DATA MODEL



LOADING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) INDIVIDUAL LOAD

1. **Locate the table in the models template**

Equipo	Nombre Equipo	Descripción	Almac	Unid. Medida	Unid. Equivale	Cod. Relación
b	Capa	Reservorio en el que se almacena el producto a ser cargado o descargado.		CANL	ESC_CAJ	COO_CAJ
c	Redes	Unidad que permite el flujo de producto entre un servicio de carga y otro.		INDOS	ESC_MDO	COO_MDO
n	Redes (Red)	Unidad que permite el flujo de producto entre un servicio de carga y otro.		INDOS	ESC_MDO	COO_MDO
v	Veículos	Equipo de transporte a utilizar para prestar los servicios de transporte.		ESC_VEH	ESC_VEH	COO_VEH
w	Redes	Equipo de transferencia que realice los cambios de orden en descargas y transportes.		REBOS	ESC_REB	COO_REB

2. **Create a new EXCEL book**

3. **Copy the table to the new book. You must delete the second row**

4. **Save the tables as a .CSV file**

It is suggested to use the same name of the sheet of the template

1. **Locate the destination table in the explorer of OPTEX-GUI**

2. **Open the DBF table in OPTEX-GUI**

3. **Import the tables based on the service**

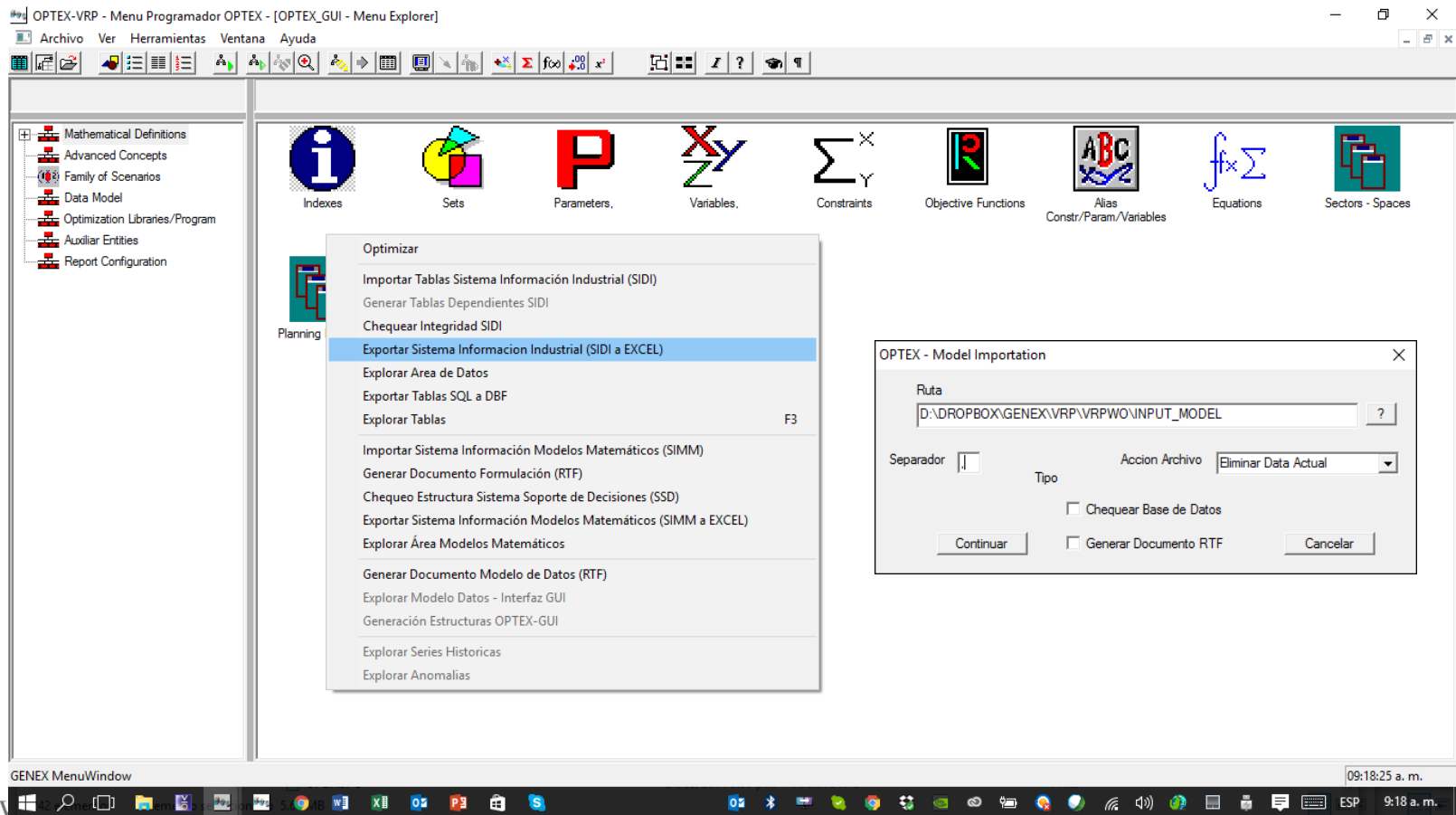
Import a text file

8. **Check the loaded table in DBF format**

For the individual import of a table it is suggested to follow included in the Tutorial Manual (section 6.2.1.)

LOADING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) MASSIVE LOAD

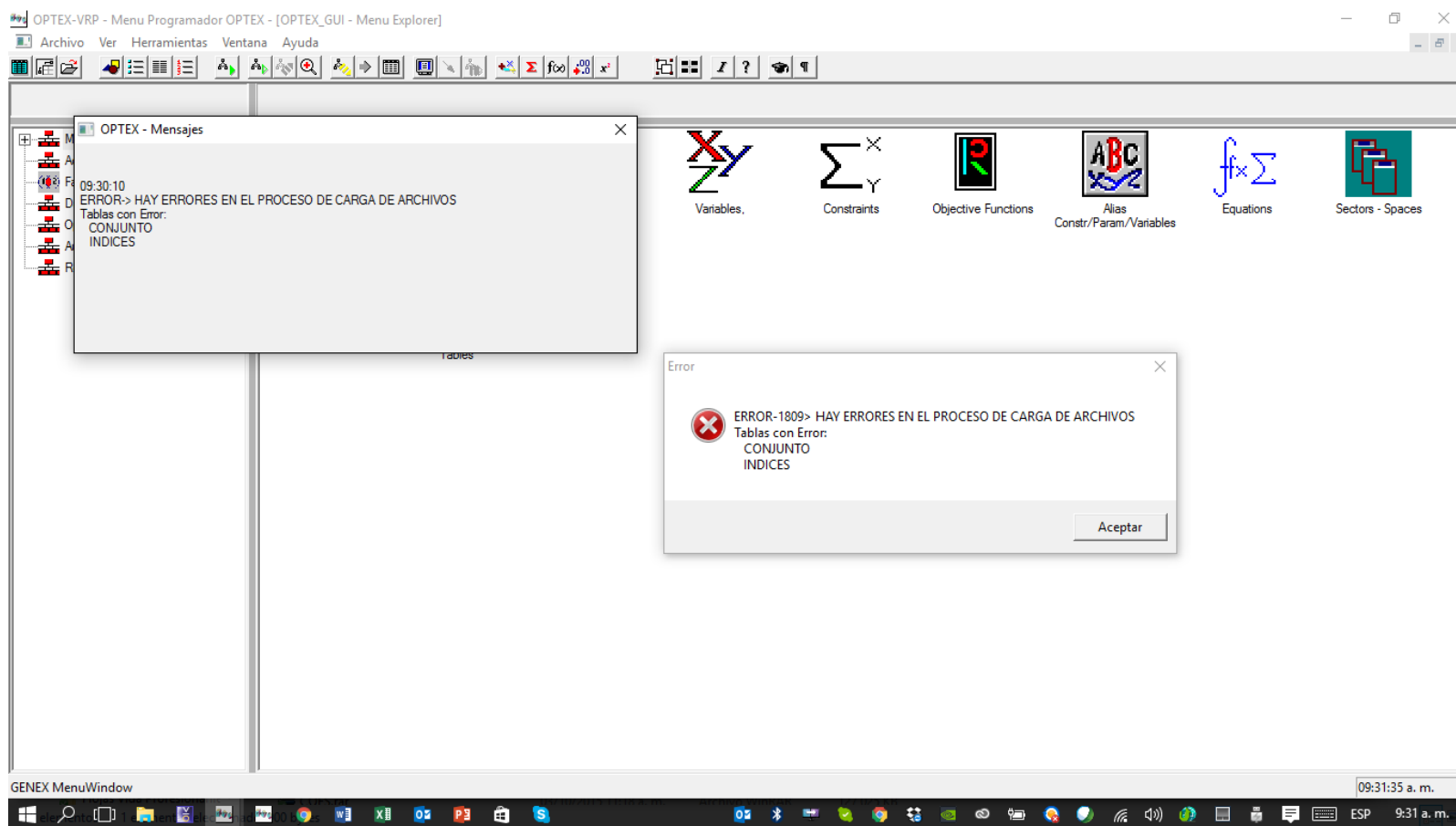
Alternatively, and in a more effective way, it is possible to load all the information contained in the EXCEL template, in one step, via of a specialized service of **OPTeX** for this purpose which is accessed via the right-click on the mouse when you are in the Explorer Menu of the mathematical models.



The screenshot displays the OPTeX GUI interface. On the left, the 'Menu Programador OPTeX - [OPTeX_GUI - Menu Explorer]' window shows a tree view of 'Mathematical Definitions' including 'Advanced Concepts', 'Family of Scenarios', 'Data Model', 'Optimization Libraries/Program', 'Auxiliar Entities', and 'Report Configuration'. The main workspace contains icons for 'Indexes', 'Sets', 'Parameters', 'Variables', 'Constraints', 'Objective Functions', 'Alias Constr./Param./Variables', 'Equations', and 'Sectors - Spaces'. A context menu is open over the 'Planning' icon, listing various actions such as 'Optimizar', 'Importar Tablas Sistema Información Industrial (SIDI)', 'Exportar Sistema Información Industrial (SIDI a EXCEL)', and 'Generar Documento Modelo de Datos (RTF)'. An 'OPTeX - Model Importation' dialog box is also shown, with the 'Ruta' field set to 'D:\DROPOBOX\GENEX\VRP\VRPWO\INPUT_MODEL', 'Separador' set to '|', and 'Accion Archivo' set to 'Eliminar Data Actual'. The system tray at the bottom shows the time as 09:18:25 a. m. and the language as ESP.

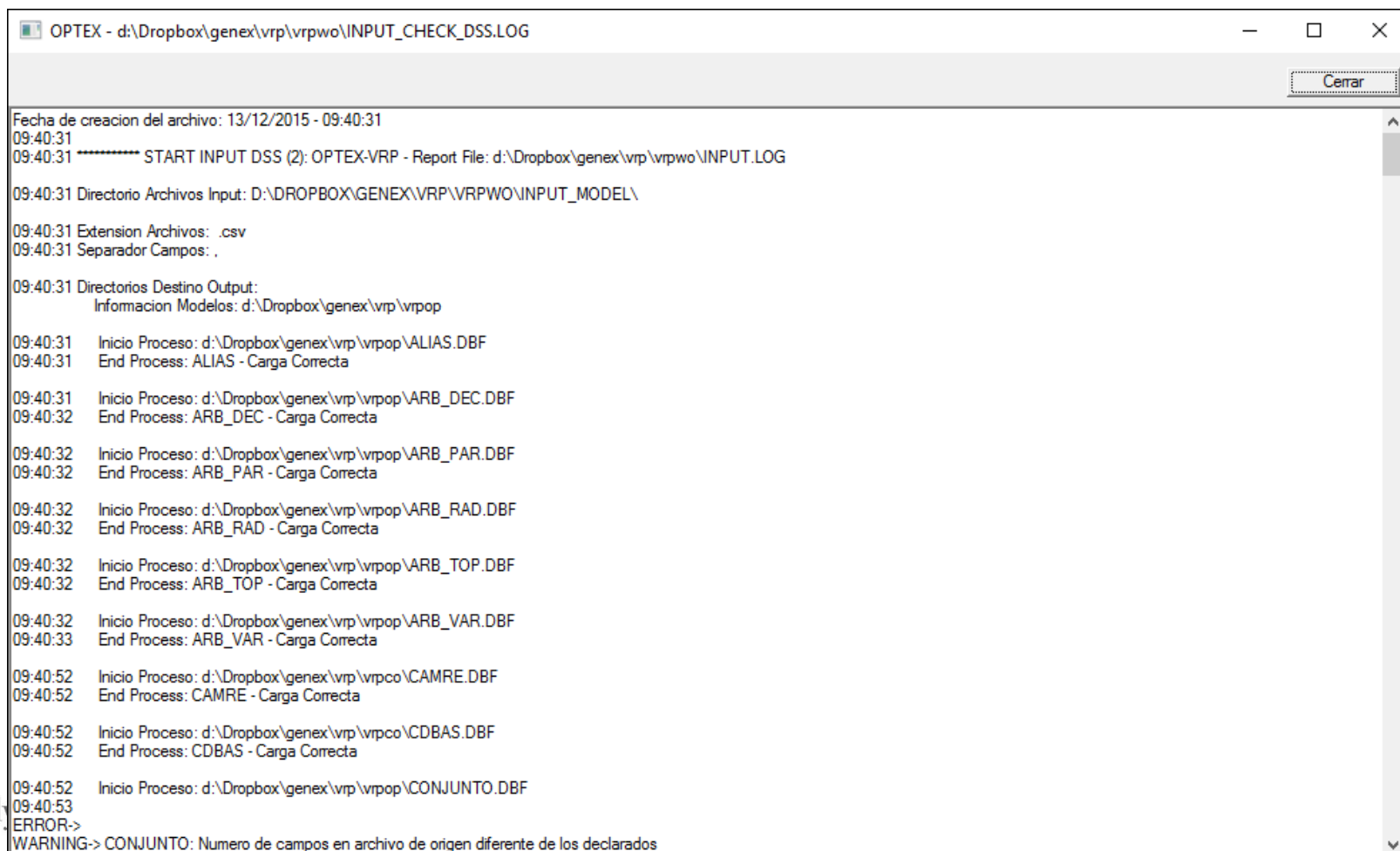
LOADING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) MASSIVE LOAD

All CVSs tables should be located in the same directory with names equal to the sheets of the EXCEL template, which you can do with the OPTeX complements to export EXCEL templates to files CVSs. The user must choose the delimiter with which CVSs files were created, in this aspect should **be careful** in the drafting of the long descriptions, since they may contain common delimiters as the comma, semicolon,..., this confusion can cause errors in loading data. OPTeX will generate a report of errors.



LOADING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) MASSIVE LOAD

Subsequently, OPTeX will check the structure and the data store in the tables to verify the integrity of the MMIS; process report is located in the INPUT_CHECK_DSS. LOG file in the work directory of the OPTeX application; which can review with any text editor, e.g. NOTEPAD.



```

OPTeX - d:\Dropbox\genex\vrp\vrpwo\INPUT_CHECK_DSS.LOG
Fecha de creacion del archivo: 13/12/2015 - 09:40:31
09:40:31
09:40:31 ***** START INPUT DSS (2): OPTeX-VRP - Report File: d:\Dropbox\genex\vrp\vrpwo\INPUT.LOG
09:40:31 Directorio Archivos Input: D:\DROPBOX\GENEX\VRP\VRPWO\INPUT_MODEL\
09:40:31 Extension Archivos: .csv
09:40:31 Separador Campos: ,
09:40:31 Directorios Destino Output:
          Informacion Modelos: d:\Dropbox\genex\vrp\vrpop
09:40:31 Inicio Proceso: d:\Dropbox\genex\vrp\vrpop\ALIAS.DBF
09:40:31 End Process: ALIAS - Carga Correcta
09:40:31 Inicio Proceso: d:\Dropbox\genex\vrp\vrpop\ARB_DEC.DBF
09:40:32 End Process: ARB_DEC - Carga Correcta
09:40:32 Inicio Proceso: d:\Dropbox\genex\vrp\vrpop\ARB_PAR.DBF
09:40:32 End Process: ARB_PAR - Carga Correcta
09:40:32 Inicio Proceso: d:\Dropbox\genex\vrp\vrpop\ARB_RAD.DBF
09:40:32 End Process: ARB_RAD - Carga Correcta
09:40:32 Inicio Proceso: d:\Dropbox\genex\vrp\vrpop\ARB_TOP.DBF
09:40:32 End Process: ARB_TOP - Carga Correcta
09:40:32 Inicio Proceso: d:\Dropbox\genex\vrp\vrpop\ARB_VAR.DBF
09:40:33 End Process: ARB_VAR - Carga Correcta
09:40:52 Inicio Proceso: d:\Dropbox\genex\vrp\vrpco\CAMRE.DBF
09:40:52 End Process: CAMRE - Carga Correcta
09:40:52 Inicio Proceso: d:\Dropbox\genex\vrp\vrpco\CDBAS.DBF
09:40:52 End Process: CDBAS - Carga Correcta
09:40:52 Inicio Proceso: d:\Dropbox\genex\vrp\vrpop\CONJUNTO.DBF
09:40:53
ERROR->
WARNING-> CONJUNTO: Numero de campos en archivo de origen diferente de los declarados
  
```



CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS)

Below, it is the process to be followed once all the tables that are part of the MMIS; this process is oriented to present the services provided by OPTEX to facilitate implementation, correction and the startup of the system of mathematical models. This will be followed as a guide errors reported in the massive process, corrections will be made in the EXCEL template.

The template and the log file resulting from the review process are at the URLs:

- http://www.doanalytics.net/Documents/OPTEX_Plantilla_Modelo_VRP-v03.xlsx
- http://www.doanalytics.net/Documents/INPUT_CHECK_DSS_3.LOG

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS)

INDEXes

The following image presents the information load and the reported errors, which are related to the existence of commas in the DLES_IND field. **The solution may be to change the delimiter or to remove commas from the long descriptions.**

The screenshot shows the OPTEX-VRP software interface. The main window displays a table of Indexes with the following data:

Code	Spanish Desc.	Alias Index	Index Type	Entity Type	Cod_Uopss:	Sector	Data Table	RelationalField	Georeference
b	Cajas		A				ESC_CAJ	COD_CAJ	Recipiente en el que se protege
c	Nodo	k	A				ESC_NOD	COD_NOD	Punto espacial que debe ser visitado por un vehículo para prestar un servicio de carga y/c
k	Nodo (Alias)	c	A				ESC_NOD1	COD_NOD1	Punto espacial que debe ser visitado por un vehículo para prestar un servicio de carga y/c
v	Vehículo		A				ESC_VEH	COD_VEH	Equipo de transporte a utilizar para prestar los servicios de transporte
w	Pedido		A				ESC_PED	COD_PED	Encargo de mercancía que realizan los clientes y deben ser despachados y transportados

An error log window titled 'INPUT_CHECK_DSS.LOG: Bloc de notas' is open in the foreground, showing the following log entries:

```

09:40:56 End Process: HORIZONT - Carga Correcta
09:40:56 Inicio Proceso: d:\Dropbox\genex\vrp\vrpop\HOR_HOR.DBF
09:40:56 End Process: HOR_HOR - Carga Correcta
09:40:56 Inicio Proceso: d:\Dropbox\genex\vrp\vrpop\HOR_MAES.DBF
09:40:56 End Process: HOR_MAES - Carga Correcta
09:40:56 Inicio Proceso: d:\Dropbox\genex\vrp\vrpop\INDICES.DBF
09:40:57 ERROR->
WARNING-> INDICES: Numero de campos en archivo de origen diferente de los declarados
en b,Cajas,,A,,,ESC_CAJ,COD_CAJ,,Recipiente en el que se protege, almacena y transporta la mercancía,
  
```

The error message indicates a mismatch in the number of fields in the source file for the 'INDICES' table, specifically pointing to the entry for 'Cajas' where commas in the description are causing the issue.

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) SETS

The following image presents the information load and the reported errors, which are related to the existence of commas in the DLES_CON field. **The solution may be to change the delimiter or to remove commas from the long descriptions.**

The screenshot shows the OPTeX-VRP - Sets - [Sets] application. The main window displays a table of sets with the following columns: Code, Spanish Description, Free Index, Dependent, Data Table, Element Field, Index Field 1, Index Field 2, Index Field 3, Operation, and Set 1.

Code	Spanish Description	Free Index	Dependent	Data Table	Element Field	Index Field 1	Index Field 2	Index Field 3	Operation	Set 1
CAC	Cajas que deben ser transportadas al nodo	c	b						S	PEC
CAP	Cajas -> Pedido	w	b	PED_CAJ	COD_CAJ	COD_PED			-	
DEC	Destinos c		c	NODOS	COD_NOD				F	
DEK	Destinos k		k	NODOS	COD_NOD				F	
DKC	Destinos k -> Destino c	c	k						I	DEK
NCV	Nodos c <- Vehículos	v	c	VEH_NOD	COD_NOD	COD_VEH			-	
NKV	Nodos k <- Vehículos	v	k	VEH_NOD	COD_NOD	COD_VEH			-	
NOC	Nodo Origen -> Nodo Destino	k	c	NOD_NOD	COD_NOD	COD_NOD1			F	
NOD	Nodos		c	NODOS	COD_NOD				-	
NOK	Nodo Destino -> Nodo Origen	c	k	NOD_NOD	COD_NOD1	COD_NOD			F	
NOV	Nodo Origen <- Vehículos	v	c	NOR_VEH	COD_NOD	COD_VEH			-	
PEC	Pedidos -> Clientes	c	w	PEDIDOS	COD_PED	COD_NOD			-	
TKD	Caminos Sobre los Cuales Puede Transitar el Vehículo (Destinos)	c	v	I					k	
TRC	Caminos Sobre los Cuales Puede Transitar el Vehículo (Destinos)									
TRK	Caminos Sobre los Cuales Puede Transitar el Vehículo (Destinos)									
VEC	Vehículos -> Nodos									
VEH	Vehículos									
VEK	Vehículos -> Nodos Destino k									
VET	Vehículos que Pueden Transitar por los Caminos									

An overlaid log window titled 'INPUT_CHECK_DSS.LOG: Bloc de notas' shows the following log entries:

```

09:40:33 End Process: ARB_VAR - Carga Correcta
09:40:52 Inicio Proceso: d:\Dropbox\genex\vrp\vrpco\CAMRE.DBF
09:40:52 End Process: CAMRE - Carga Correcta
09:40:52 Inicio Proceso: d:\Dropbox\genex\vrp\vrpco\CDBAS.DBF
09:40:52 End Process: CDBAS - Carga Correcta
09:40:52 Inicio Proceso: d:\Dropbox\genex\vrp\vrpop\CONJUNTO.DBF
09:40:53 ERROR->
WARNING-> CONJUNTO: Numero de campos en archivo de origen diferente de los declarados
en TRC,Caminos Sobre los Cuales Puede Transitar el Vehículo,k,v,c,I,,,NCV,NOC,,,,,,
  
```

The bottom of the screenshot shows the taskbar with the system clock at 10:19:06 a.m. and the text 'GENEX Super Data Window' in the bottom left corner.

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) SETs

Given that the error occurs on the TRC set which is indexed by two indexes (k,v) and representation of this includes the separating comma, the required solution is to change the delimiter of comma (,) by semicolon (;) or another appropriate delimiter.

	A	B	C	D	E	F	G	H	I	J	K
1	COD_CON	DES_CON	COD_IND	OD_IND_I	COD_OPE	COD_DB	CAMPO_ELE	CAMPO_FIL	CONJUNTO_1	CONJUNTO_2	VALOR_FIL
15	PEC	Pedidos -> Clientes Cajas que deben ser transportadas al nodo	c	w	-	PEDIDOS	COD_PED	COD_NOD			
16	CAC	Caminos Sobre los Cuales Puede Transitar el Vehículo	c	b	S				PEC	CAP	
17	TRC	Destinos k -> Destino c	k,v	c	I				NCV	NOC	
18	DKC	Caminos Sobre los Cuales Puede Transitar el Vehículo (Destinos)	c	k	I				DEK	NOK	
19	TKD	Caminos Sobre los Cuales Puede Transitar el Vehículo	c,v		I				TRK	DEK	
20	TRK		c,v	k	I				NKV	NOK	

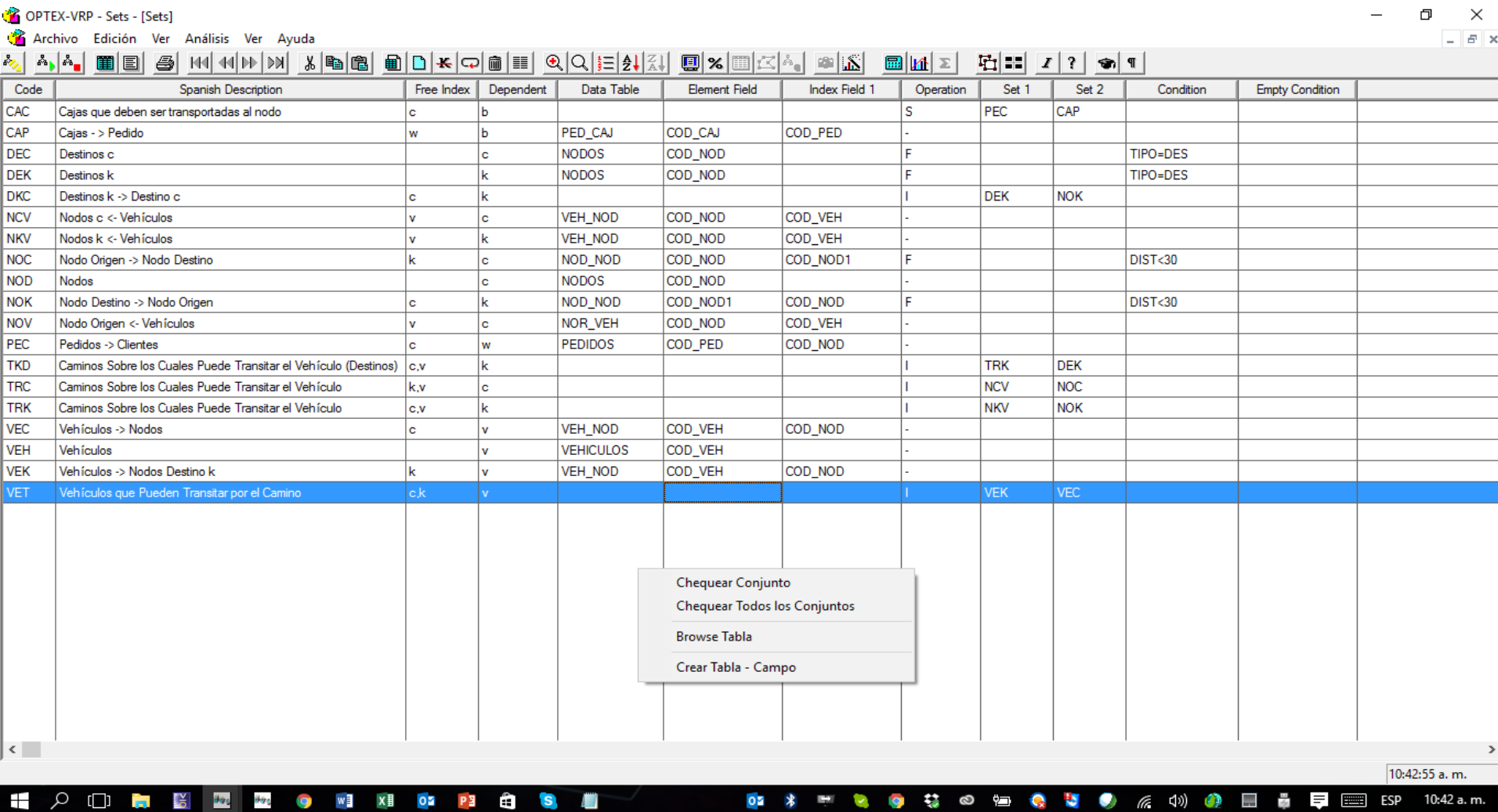
At this point, it is convenient to reimport the database of mathematical models using the semicolon (;) as a delimiter. This means repeats the process from the generation of CSV files. The following image shows the result of the process which no longer presents data from the EXCEL template import errors. The new report of the process is located in.

- http://www.doanalytics.net/Documents/INPUT_CHECK_DSS_2.LOG

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS)

SETS

The next step is to review the sets which can be done through the special services offered by OPTeX which is accessed through the right-click of the mouse, as shown in the following image.



The screenshot shows the OPTeX-VRP - Sets - [Sets] application window. The main area displays a table of sets with the following columns: Code, Spanish Description, Free Index, Dependent, Data Table, Element Field, Index Field 1, Operation, Set 1, Set 2, Condition, and Empty Condition. The row for 'VEK' is highlighted in blue, and a context menu is open over it, showing options: 'Chequear Conjunto', 'Chequear Todos los Conjuntos', 'Browse Tabla', and 'Crear Tabla - Campo'.

Code	Spanish Description	Free Index	Dependent	Data Table	Element Field	Index Field 1	Operation	Set 1	Set 2	Condition	Empty Condition
CAC	Cajas que deben ser transportadas al nodo	c	b				S	PEC	CAP		
CAP	Cajas -> Pedido	w	b	PED_CAJ	COD_CAJ	COD_PED	-				
DEC	Destinos c		c	NODOS	COD_NOD		F			TIPO=DES	
DEK	Destinos k		k	NODOS	COD_NOD		F			TIPO=DES	
DKC	Destinos k -> Destino c	c	k				I	DEK	NOK		
NCV	Nodos c <- Vehículos	v	c	VEH_NOD	COD_NOD	COD_VEH	-				
NKV	Nodos k <- Vehículos	v	k	VEH_NOD	COD_NOD	COD_VEH	-				
NOC	Nodo Origen -> Nodo Destino	k	c	NOD_NOD	COD_NOD	COD_NOD1	F			DIST<30	
NOD	Nodos		c	NODOS	COD_NOD		-				
NOK	Nodo Destino -> Nodo Origen	c	k	NOD_NOD	COD_NOD1	COD_NOD	F			DIST<30	
NOV	Nodo Origen <- Vehículos	v	c	NOR_VEH	COD_NOD	COD_VEH	-				
PEC	Pedidos -> Clientes	c	w	PEDIDOS	COD_PED	COD_NOD	-				
TKD	Caminos Sobre los Cuales Puede Transitar el Vehículo (Destinos)	c,v	k				I	TRK	DEK		
TRC	Caminos Sobre los Cuales Puede Transitar el Vehículo	k,v	c				I	NCV	NOC		
TRK	Caminos Sobre los Cuales Puede Transitar el Vehículo	c,v	k				I	NKV	NOK		
VEC	Vehículos -> Nodos	c	v	VEH_NOD	COD_VEH	COD_NOD	-				
VEH	Vehículos		v	VEHICULOS	COD_VEH		-				
VEK	Vehículos -> Nodos Destino k	k	v	VEH_NOD	COD_VEH	COD_NOD	-				
VET	Vehículos que Pueden Transitar por el Camino	c,k	v				I	VEK	VEC		

Chequear Conjunto

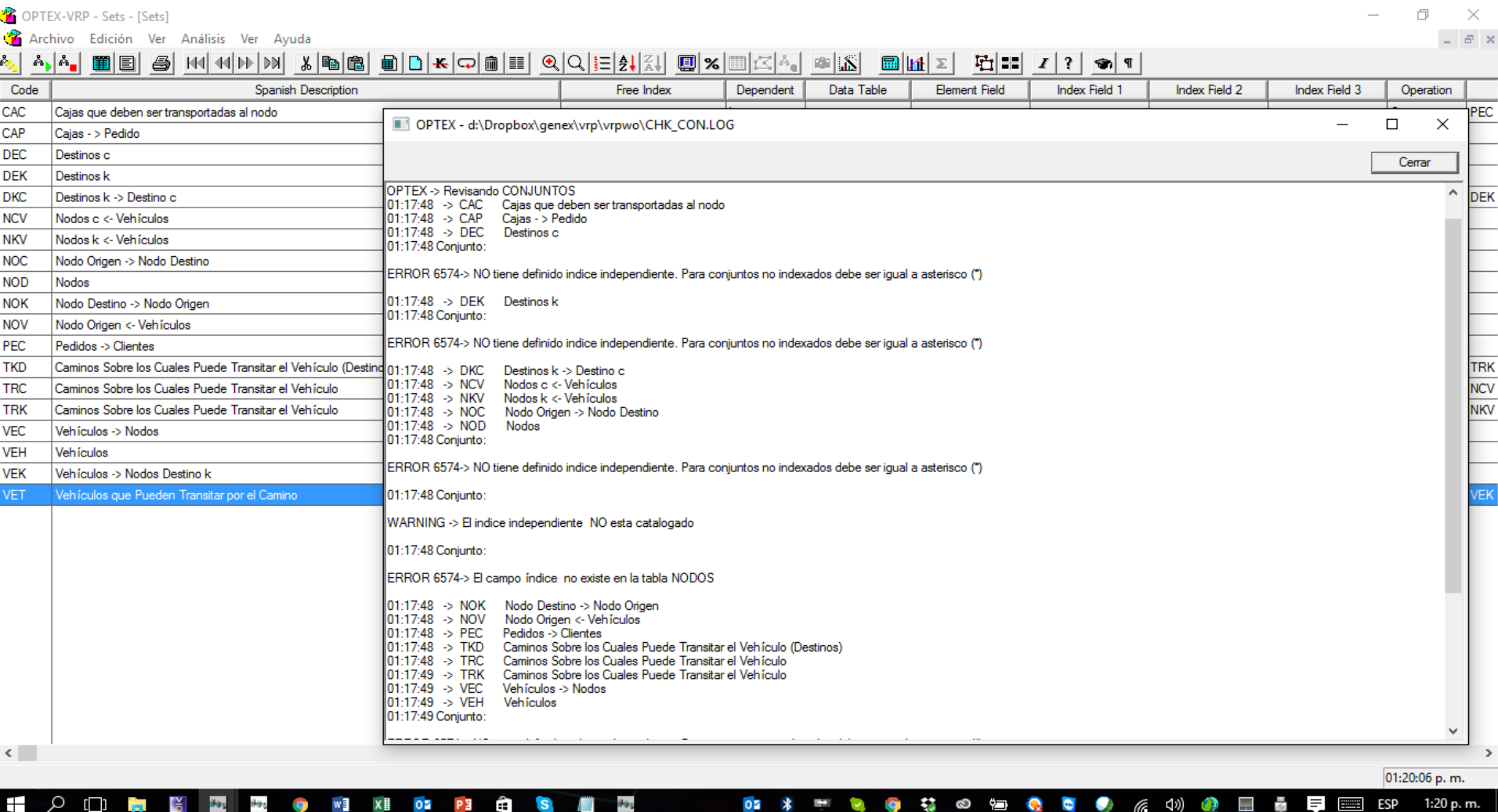
Chequear Todos los Conjuntos

Browse Tabla

Crear Tabla - Campo

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) SETS

When you run CHECK ALL SETS (Chequear Todos los Conjuntos), OPTeX will generate a report which indicates the existing errors related to the table CONJUNTO (SET).



The screenshot shows the OPTeX-VRP software interface. On the left, there is a table with columns: Code, Spanish Description, Free Index, Dependent, Data Table, Element Field, Index Field 1, Index Field 2, Index Field 3, and Operation. The table lists various sets such as CAC, CAP, DEC, DEK, DKC, NCV, NKV, NOC, NOD, NOK, NOV, PEC, TKD, TRC, TRK, VEC, VEH, VEK, and VET.

On the right, a log window titled "OPTeX - d:\Dropbox\genex\vrp\vrpwo\CHK_CON.LOG" displays the output of the "CHECK ALL SETS" operation. The log shows the following content:

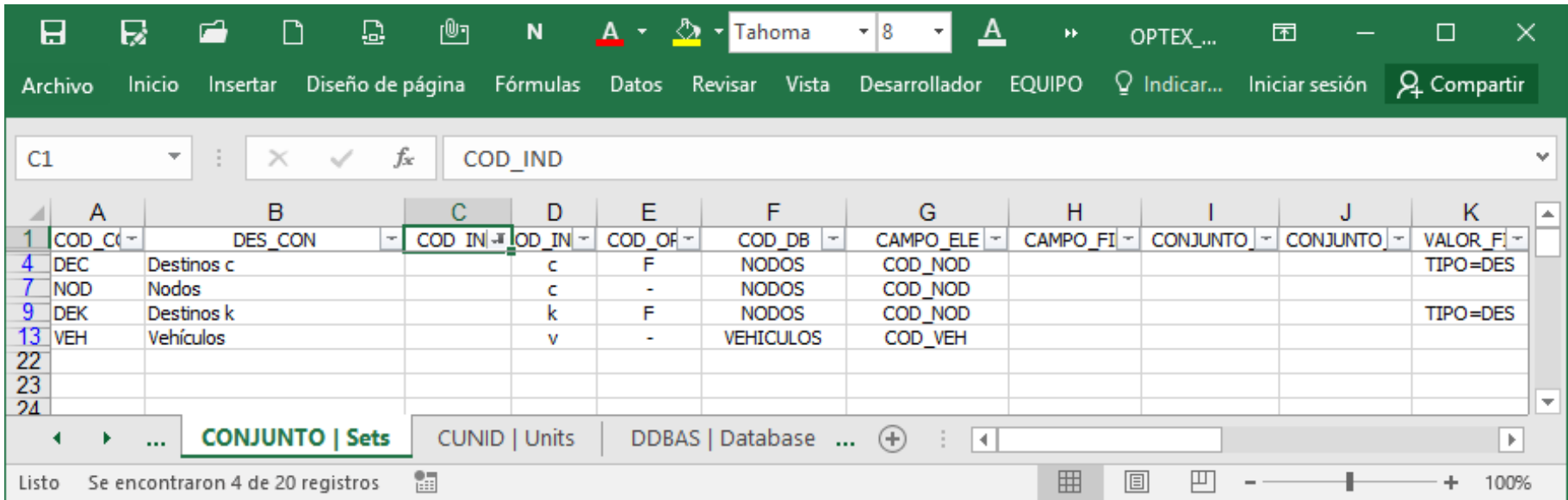
```

OPTeX -> Revisando CONJUNTOS
01:17:48 -> CAC Cajas que deben ser transportadas al nodo
01:17:48 -> CAP Cajas -> Pedido
01:17:48 -> DEC Destinos c
01:17:48 Conjunto:
ERROR 6574-> NO tiene definido indice independiente. Para conjuntos no indexados debe ser igual a asterisco (*)
01:17:48 -> DEK Destinos k
01:17:48 Conjunto:
ERROR 6574-> NO tiene definido indice independiente. Para conjuntos no indexados debe ser igual a asterisco (*)
01:17:48 -> DKC Destinos k -> Destino c
01:17:48 -> NCV Nodos c <- Vehículos
01:17:48 -> NKV Nodos k <- Vehículos
01:17:48 -> NOC Nodo Origen -> Nodo Destino
01:17:48 -> NOD Nodos
01:17:48 Conjunto:
ERROR 6574-> NO tiene definido indice independiente. Para conjuntos no indexados debe ser igual a asterisco (*)
01:17:48 Conjunto:
WARNING -> El indice independiente NO esta catalogado
01:17:48 Conjunto:
ERROR 6574-> El campo índice no existe en la tabla NODOS
01:17:48 -> NOK Nodo Destino -> Nodo Origen
01:17:48 -> NOV Nodo Origen <- Vehículos
01:17:48 -> PEC Pedidos -> Clientes
01:17:48 -> TKD Caminos Sobre los Cuales Puede Transitar el Vehículo (Destinos)
01:17:48 -> TRC Caminos Sobre los Cuales Puede Transitar el Vehículo
01:17:49 -> TRK Caminos Sobre los Cuales Puede Transitar el Vehículo
01:17:49 -> VEC Vehículos -> Nodos
01:17:49 -> VEH Vehículos
01:17:49 Conjunto:
  
```

The taskbar at the bottom shows the system time as 01:20:06 p. m. and the language as ESP.

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) SETs

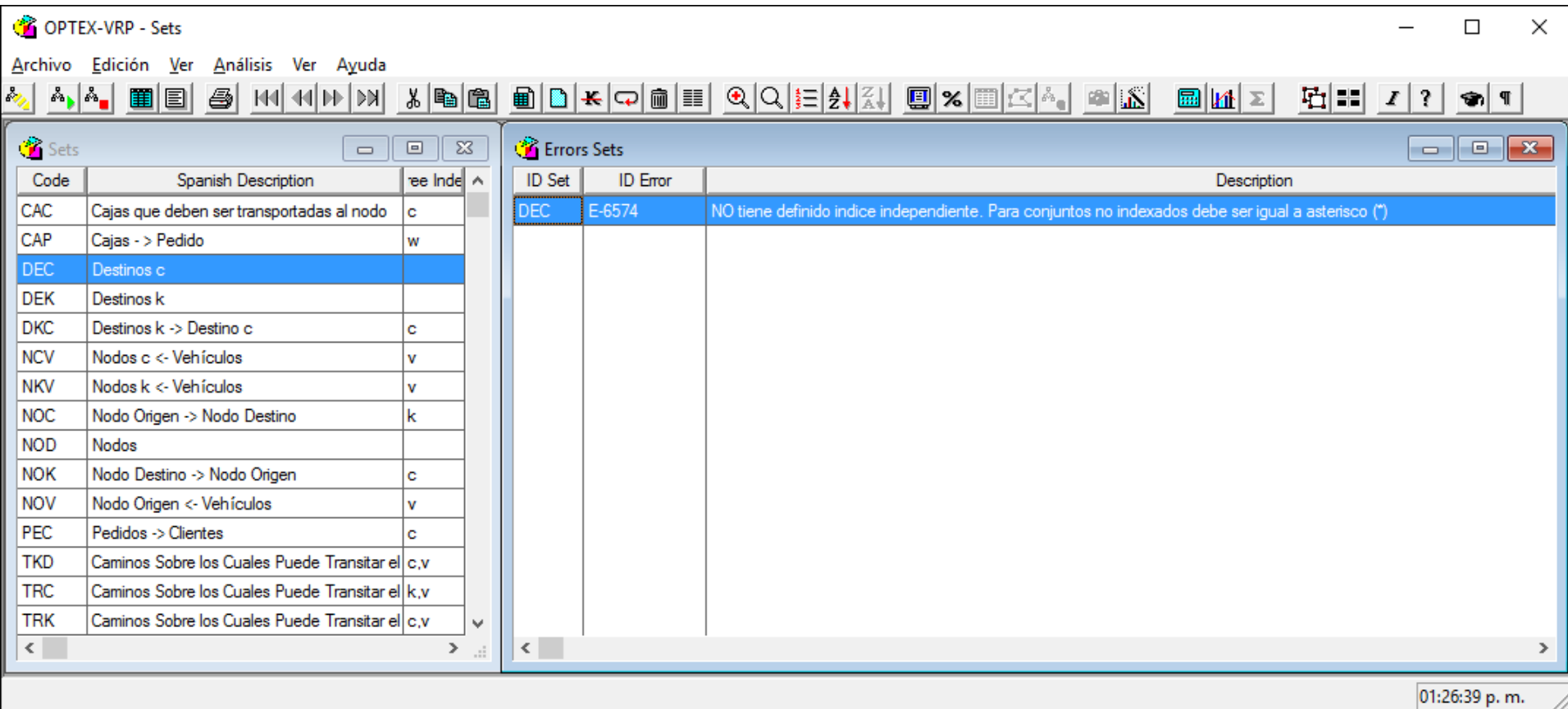
Reported errors are due to that when the set is non-indexed (does not depend on any index) the corresponding field (COD_IND) should be filled with an asterisk (*). The image displayed in the EXCEL template sets with errors.



	A	B	C	D	E	F	G	H	I	J	K
1	COD_CC	DES_CON	COD_IN	COD_OF	COD_DB	CAMPO_ELE	CAMPO_FI	CONJUNTO	CONJUNTO	VALOR_FI	
4	DEC	Destinos c		c	F	NODOS	COD_NOD			TIPO=DES	
7	NOD	Nodos		c	-	NODOS	COD_NOD				
9	DEK	Destinos k		k	F	NODOS	COD_NOD			TIPO=DES	
13	VEH	Vehículos		v	-	VEHICULOS	COD_VEH				
22											
23											
24											

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) SETS

OPTEX stored in tables the errors found, so that the user can access from the associated container window. Errors are stored in tables called **ERR_XXX** where it is associated with the code of the mathematical entity, in this case the table used is **ERR_CON** which it is accessed from the File menu option **OPEN TABLE RELATED** (first button on the left of the toolbar), this at all master tables related to the mathematical elements.



The screenshot shows the OPTEX-VRP - Sets application window. The main window is divided into two panes. The left pane, titled 'Sets', displays a table of mathematical sets. The right pane, titled 'Errors Sets', displays a table of errors associated with the selected set.

Code	Spanish Description	ree Inde
CAC	Cajas que deben ser transportadas al nodo	c
CAP	Cajas -> Pedido	w
DEC	Destinos c	
DEK	Destinos k	
DKC	Destinos k -> Destino c	c
NCV	Nodos c <- Vehículos	v
NKV	Nodos k <- Vehículos	v
NOC	Nodo Origen -> Nodo Destino	k
NOD	Nodos	
NOK	Nodo Destino -> Nodo Origen	c
NOV	Nodo Origen <- Vehículos	v
PEC	Pedidos -> Clientes	c
TKD	Caminos Sobre los Cuales Puede Transitar el	c,v
TRC	Caminos Sobre los Cuales Puede Transitar el	k,v
TRK	Caminos Sobre los Cuales Puede Transitar el	c,v

ID Set	ID Error	Description
DEC	E-6574	NO tiene definido indice independiente. Para conjuntos no indexados debe ser igual a asterisco (*)

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) PARAMETERS

The image below presents reported errors in the load of the parameters which are related to the parameters CVIA, DEMP and DEMB. The errors presented for each parameter which are all due to that parameter indexes were not included in the table PAR_IND that contains the relationship between parameters and indexes.

```

OPTEX - d:\Dropbox\genex\vrp\vrpwo\CHK_PAR.LOG
Cerrar

OPTEX -> Revisando PARAMETROS
01:35:26 -> CAPP Capacidad del Vehículo en Peso
01:35:26 -> CAPV Capacidad del Vehículo en Volumen
01:35:26 -> CFUJ Costo Fijo de Utilizar el Vehículo v
01:35:26 -> COVA Costo Variable de Utilizar un Vehículo
01:35:26 -> CVIA Costo de Viaje Entre Nodos
01:35:26 Parámetro: CVIA

ERROR 6751-> Secuencia: 1 - El parametro COVA tiene el indice v que no se puede resolver
01:35:26 Parámetro: CVIA

ERROR 6751-> Secuencia: 1 - El parametro DIST tiene el indice c que no se puede resolver
01:35:26 Parámetro: CVIA

ERROR 6751-> Secuencia: 1 - El parametro DIST tiene el indice k que no se puede resolver
01:35:26 -> DEMP Demanda en Peso
01:35:26 Parámetro: DEMP

ERROR 6751-> Secuencia: 1 - c indice independiente del conjunto CAC no puede resolverse
01:35:26 Parámetro: DEMP

ERROR 6751-> Secuencia: 2 - El parametro NUCD no esta catalogado
01:35:26 -> DEMV Demanda en Volumen
01:35:26 Parámetro: DEMV

ERROR 6751-> Secuencia: 1 - c indice independiente del conjunto CAC no puede resolverse
01:35:26 Parámetro: DEMV

ERROR 6751-> Secuencia: 2 - El parametro NUCD no esta catalogado
01:35:26 -> DIST Distancia Nodos
01:35:26 -> NUCA Número de Cajas del Pedido
01:35:26 -> PECA Peso Caja
01:35:26 -> VOCA Volumen de las Cajas
  
```

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) PARAMETERS

The image below presents reported errors in the load of the parameters which are related to the parameters CVIA, DEMP and DEMB. The errors presented for each parameter which are all due to that parameter indexes were not included in the table PAR_IND that contains the relationship between parameters and indexes.

```

OPTEX - d:\Dropbox\genex\vrp\vrpwo\CHK_PAR.LOG
OPTEX -> Revisando PARAMETROS
01:35:26 -> CAPP  Capacidad del Vehículo en Peso
01:35:26 -> CAPV  Capacidad del Vehículo en Volumen
01:35:26 -> CFUJ  Costo Fijo de Utilizar el Vehículo v
01:35:26 -> COVA  Costo Variable de Utilizar un Vehículo
01:35:26 -> CVIA  Costo de Viaje Entre Nodos
01:35:26 Parámetro: CVIA

ERROR 6751-> Secuencia: 1 - El parametro COVA tiene el indice v que no se puede resolver
01:35:26 Parámetro: CVIA

ERROR 6751-> Secuencia: 1 - El parametro DIST tiene el indice c que no se puede resolver
01:35:26 Parámetro: CVIA

ERROR 6751-> Secuencia: 1 - El parametro DIST tiene el indice k que no se puede resolver
01:35:26 -> DEMP  Demanda en Peso
01:35:26 Parámetro: DEMP

ERROR 6751-> Secuencia: 1 - c indice independiente del conjunto CAC no puede resolverse
01:35:26 Parámetro: DEMP

ERROR 6751-> Secuencia: 2 - El parametro NUCD no esta catalogado
01:35:26 -> DEMV  Demanda en Volumen
01:35:26 Parámetro: DEMV

ERROR 6751-> Secuencia: 1 - c indice independiente del conjunto CAC no puede resolverse
01:35:26 Parámetro: DEMV

ERROR 6751-> Secuencia: 2 - El parametro NUCD no esta catalogado
01:35:26 -> DIST  Distancia Nodos
01:35:26 -> NUCA  Número de Cajas del Pedido
01:35:26 -> PECA  Peso Caja
01:35:26 -> VOCA  Volumen de las Cajas
  
```



1. PARAMETER: CVIA

$$CVIA_{v,c,k} = COVA_v \times DIST_{c,k}$$

The screenshot shows the 'Parameters' window with the following data:

Code	Spanish Desc.	English Desc.	Unit	Type T
CAPP	Capacidad del Vehículo en Peso		kg	R
CAPV	Capacidad del Vehículo en Volumen		m3	R
CFU	Costo Fijo de Utilizar el Vehículo v		\$/día	R
COVA	Costo Variable de Utilizar un Vehículo		\$/km	R
CVIA	Costo de Viaje Entre Nodos		\$	C
DEMP	Demanda en Peso		kg	C
DEMV	Demanda en Volumen		m3	C

The 'Errors Parameters' window shows the following error messages:

ID Parameter	ID Error	Description
CVIA	E-6751	Secuencia 1 - El parametro COVA tiene el indice v que no se puede resolver
CVIA	E-6751	Secuencia 1 - El parametro DIST tiene el indice c que no se puede resolver
CVIA	E-6751	Secuencia 1 - El parametro DIST tiene el indice k que no se puede resolver

The 'Parameter Equation' window shows the equation for CVIA:

Parameter	#	(+ or -)	Component 1	Component 2	Component 3	Vari
CVIA	1	+	COVA	DIST		

2. PARAMETER: DEMP

$$DEMP_c = \sum_{b \in CAC(c)} NUCD_{c,b} \times PECA_b$$

In addition, the **NUCD** parameter is not listed, since it was forgotten in the original formulation. It must be included the **NUCD** parameter in the system.

The screenshot shows the 'Parameters' window with the following data:

Code	Spanish Desc.	English Desc.	Unit	Type T
CAPP	Capacidad del Vehículo en Peso		kg	R
CAPV	Capacidad del Vehículo en Volumen		m3	R
CFU	Costo Fijo de Utilizar el Vehículo v		\$/día	R
COVA	Costo Variable de Utilizar un Vehículo		\$/km	R
CVIA	Costo de Viaje Entre Nodos		\$	C
DEMP	Demanda en Peso		kg	C
DEMV	Demanda en Volumen		m3	C

The 'Errors Parameters' window shows the following error messages:

ID Parameter	ID Error	Description
DEMP	E-6751	Secuencia 1 - c indice independiente del conjunto CAC no puede resolverse
DEMP	E-6751	Secuencia 2 - El parametro NUCD no esta catalogado

The 'Parameter Equation' window shows the equation for DEMP:

Parameter	#	(+ or -)	Component 1	Component 2	Component 3	Vari
DEMP	1	+	\$	b/CAC		
DEMP	2	+	NUCD	PECA		

3. PARAMETER: DEMV

$$DEMV_c = \sum_{b \in CAC(c)} NUCD_{c,b} \times PECA_b$$

In addition, the **NUCD** parameter is not listed, since it was forgotten in the original formulation.

The screenshot shows the 'Parameters' window with the following data:

Code	Spanish Desc.	English Desc.	Unit	Type T
CVIA	Costo de Viaje Entre Nodos		\$	C
DEMP	Demanda en Peso		kg	C
DEMV	Demanda en Volumen		m3	C
DIST	Distancia Nodos		km	R
NUCA	Número de Cajas del Pedido		und	R
PECA	Peso Caja		kg	R
NUCD	Número de Cajas del Pedido		und	R

The 'Errors Parameters' window shows the following error messages:

ID Parameter	ID Error	Description
DEMV	E-6751	Secuencia 1 - c indice independiente del conjunto CAC no puede resolverse
DEMV	E-6751	Secuencia 2 - El parametro NUCD no esta catalogado

The 'Parameter Equation' window shows the equation for DEMV:

Parameter	#	(+ or -)	Component 1	Component 2	Component 3	Vari
DEMV	1	+	\$	b/CAC		
DEMV	2	+	NUCD	PECA		

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) PARAMETERS

The image below presents reported errors in the load of the parameters which are related to the parameters CVIA, DEMP and DEMB. The errors presented for each parameter which are all due to that parameter indexes were not included in the table PAR_IND that contains the relationship between parameters and indexes.

```

OPTEX - d:\Dropbox\genex\vrp\vrpwo\CHK_PAR.LOG
[Close]

OPTEX -> Revisando PARAMETROS
01:35:26 -> CAPP Capacidad del Vehículo en Peso
01:35:26 -> CAPV Capacidad del Vehículo en Volumen
01:35:26 -> CFUJ Costo Fijo de Utilizar el Vehículo v
01:35:26 -> COVA Costo Variable de Utilizar un Vehículo
01:35:26 -> CVIA Costo de Viaje Entre Nodos
01:35:26 Parámetro: CVIA

ERROR 6751-> Secuencia: 1 - El parametro COVA tiene el indice v que no se puede resolver
01:35:26 Parámetro: CVIA

ERROR 6751-> Secuencia: 1 - El parametro DIST tiene el indice c que no se puede resolver
01:35:26 Parámetro: CVIA

ERROR 6751-> Secuencia: 1 - El parametro DIST tiene el indice k que no se puede resolver
01:35:26 -> DEMP Demanda en Peso
01:35:26 Parámetro: DEMP

ERROR 6751-> Secuencia: 1 - c indice independiente del conjunto CAC no puede resolverse
01:35:26 Parámetro: DEMP

ERROR 6751-> Secuencia: 2 - El parametro NUCD no esta catalogado
01:35:26 -> DEMV Demanda en Volumen
01:35:26 Parámetro: DEMV

ERROR 6751-> Secuencia: 1 - c indice independiente del conjunto CAC no puede resolverse
01:35:26 Parámetro: DEMV

ERROR 6751-> Secuencia: 2 - El parametro NUCD no esta catalogado
01:35:26 -> DIST Distancia Nodos
01:35:26 -> NUCA Número de Cajas del Pedido
01:35:26 -> PECA Peso Caja
01:35:26 -> VOCA Volumen de las Cajas
  
```



CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) PARAMETERS

The correction related to the NUCD parameter is presented below

CALCULATED PARAMETERS		
PARAMETER	DESCRIPTION	UNIT
NUCD_{c,b}	<p>Boxes for customer c Total of boxes (b) must be delivered to the client c</p> $\mathbf{NUCD}_{c,b} = \sum_{w \in \text{PEC}(c)} \mathbf{NUCA}_{w,b}$ <p>Parameters: NUCA_{w,b} Number of boxes b in the order w (und)</p>	und



CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) PARAMETERS

The correction related to the NUCD parameter is presented below

BASIC PARAMETERS				
PARAMETER	DESCRIPTION	UNIT	TABLE	FIELD
$CAPP_v$	Capacity of the vehicle weight Vehicle weight capacity measured in kilograms	kg	VEHICULOS	CAPP
$CAPV_v$	Capacity of the vehicle in volume Volumetric capacity of the vehicle, measured in cubic metres	m3	VEHICULOS	CAPV
$COVA_v$	Variable costs using a vehicle Cost per kilometer by using the vehicle	\$/kmt	VEHICULOS	COVA
$CFIJ_v$	Fixed cost for using vehicle v Fixed cost of use the vehicle v	\$/día	VEHICULOS	CUVE
$DIST_{c,k}$	Distance nodes Distance between the origin node and the destination node	km	NOD_NOD	DIST
$NUCA_{w,b}$	Number of boxes of the order Number of cases order that must be transported to the node	und	PED_CAJ	NUCA
$PECA_b$	Weight box Weight of boxes in kg	kg	CAJAS	PECA
$VOCA_b$	Volume of boxes Volume of the boxes in cubic meters	m3	CAJAS	VOCA
CALCULATED PARAMETERS				
PARAMETER	DESCRIPTION	UNIT	FORMULA	
$CVIA_{v,c,k}$	Cost of travel between nodes Cost of travel of the vehicle from source node to the destination node	\$	$CVIA_{v,c,k} = COVA_v \times DIST_{c,k}$	
$DEMP_c$	Demand in weight The node demand expressed in kilograms	kg	$DEMP_c = \sum_{b \in CAC(c)} NUCD_{c,b} \times PECA_b$	
$DEMV_c$	Demand in volume Demand for the node, expressed as a volume	m3	$DEMV_c = \sum_{b \in CAC(c)} NUCD_{c,b} \times VOCA_b$	
$NUCD_{c,b}$	Boxes total for customer c Total of boxes (b) must be delivered at the client c	und	$NUCD_{c,b} = \sum_{w \in PEC(c)} NUCA_{w,b}$	

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) PARAMETERS

The following images show the corrections made in the EXCEL template.

	A	B	C	D	E	F
1	COD_PAR	DES_PAR	COD_UNI	COD_TDB	CAMPO_P	COD_DB
2	Parameter Code	Spanish Description	Parameter Unit	ID Definition Typ	Field-Variable-C	Reference Data
3	CAPP	Capacidad del Vehículo en Peso	kg	R	CAPP	VEHICULOS
4	CAPV	Capacidad del Vehículo en Volumen	m3	R	CAPV	VEHICULOS
5	COVA	Costo Variable de Utilizar un Vehículo	\$/kmt	R	COVA	VEHICULOS
6	CFD	Costo Fijo de Utilizar el Vehículo v	\$/día	R	CUVE	VEHICULOS
7	DIST	Distancia Nodos	km	R	DIST	NOD_NOD
8	NUCA	Número de Cajas del Pedido	und	R	NUCA	PED_CAJ
9	PECA	Peso Caja	kg	R	PECA	CAJAS
10	VOCA	Volumen de las Cajas	m3/und	R	VOCA	CAJAS
11	CVIA	Costo de Viaje Entre Nodos	\$	C		
12	DEMP	Demanda en Peso	kg	C		
13	DEMV	Demanda en Volumen	m3	C		
14	NUCD	Cajas Totales para el cliente	und	C		

	A	B	C	D	E	F
23		CVIA	1	+	COVA	DIST
24		DEMP	1	+	S	b/CAC
25		DEMP	2	+	NUCD	PECA
26		DEMV	1	+	S	b/CAC
27		DEMV	2	+	NUCD	PECA
28		NUCD	1	+	S	w/PEC
29		NUCD	2	+	1	NUCA

	A	B	C	D
1	COD_PAR	NIVEL	COD_IND	COD_CON
12	VOCA	1	b	
13	CVIA	1	v	
14	CVIA	1	c	
15	CVIA	1	k	
16	DEMP	1	c	
17	DEMV	1	c	
18	NUCD	1	c	
19	NUCD	2	b	

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) VARIABLES

The following image shows errors reported in the load of the variables. These errors are generated by the error of not having defined for non-indexed sets the asterisk (*) to indicate this fact.

```

INPUT_CHECK_DSS_2.LOG: Bloc de notas
Archivo Edición Formato Ver Ayuda
OPTEX -> Revisando VARIABLES
10:35:37 -> AVL Uso del vehículo v
10:35:37 Variable: AVL

ERROR 6751-> indice independiente del conjunto VEH no puede resolverse

10:35:37 -> VCL Vehículo v viaja del nodo c al nodo k
10:35:37 Variable: VCL

ERROR 6751-> indice independiente del conjunto VEH no puede resolverse
  
```

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) VARIABLEs

To correct the error in the sets definition, disappears the error in the variables, as you can see in the following image.

The screenshot shows the OPTEX-VRP - Variables application window. The main window displays a table with the following data:

Variable	Spanish Desc.	Unit	Type	Logic Variable	Upper Bound	Lower Bound	Cod_Uopss:	Priority B & B	Garitt Control	Sector	Area Decision	Function	L
AVL	Uso del vehículo v		B		1	0		0					
VCL	Vehículo v viaja del nodo c al nodo k		B		1	0		0					

An error log window is open in the foreground, displaying the following text:

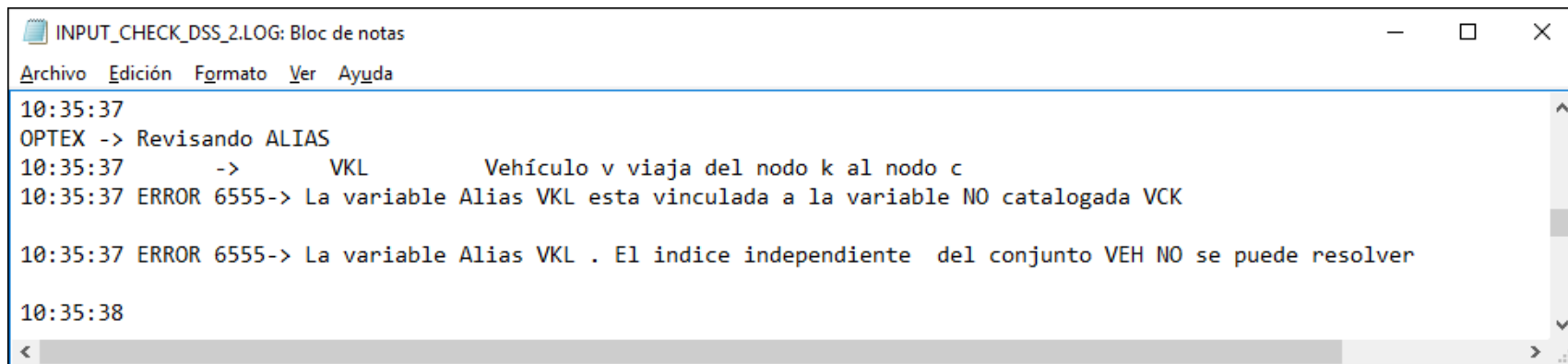
```

OPTEX - d:\Dropbox\genex\vrp\vrpwo\CHK_VAR.LOG
Fecha de creacion del archivo: 13/12/2015 - 03:27:16
03:27:16
OPTEX-> Revisando VARIABLES
03:27:16 -> AVL   Uso del vehículo v
03:27:16 -> VCL   Vehículo v viaja del nodo c al nodo k
Fecha de finalización del archivo: 13/12/2015 - 03:27:16
    
```

The system tray at the bottom right shows the time as 03:28:17 p. m. and the language as ESP.

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) VARIABLEs ALIAS

The following image shows errors reported in the variable alias load. These errors are generated by the error of not having defined for non-indexed sets the asterisk (*) as the independent index; in addition, the variable alias is associated with a non-existent variable VCK.



```

INPUT_CHECK_DSS_2.LOG: Bloc de notas
Archivo Edición Formato Ver Ayuda
10:35:37
OPTEX -> Revisando ALIAS
10:35:37 -> VKL Vehículo v viaja del nodo k al nodo c
10:35:37 ERROR 6555-> La variable Alias VKL esta vinculada a la variable NO catalogada VCK

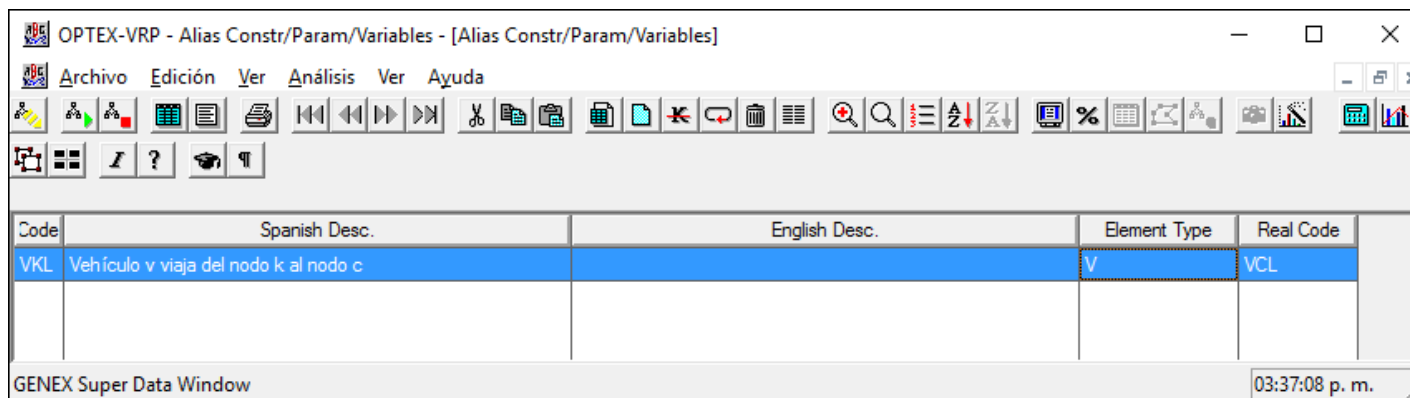
10:35:37 ERROR 6555-> La variable Alias VKL . El indice independiente del conjunto VEH NO se puede resolver

10:35:38

```

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) VARIABLEs ALIAS

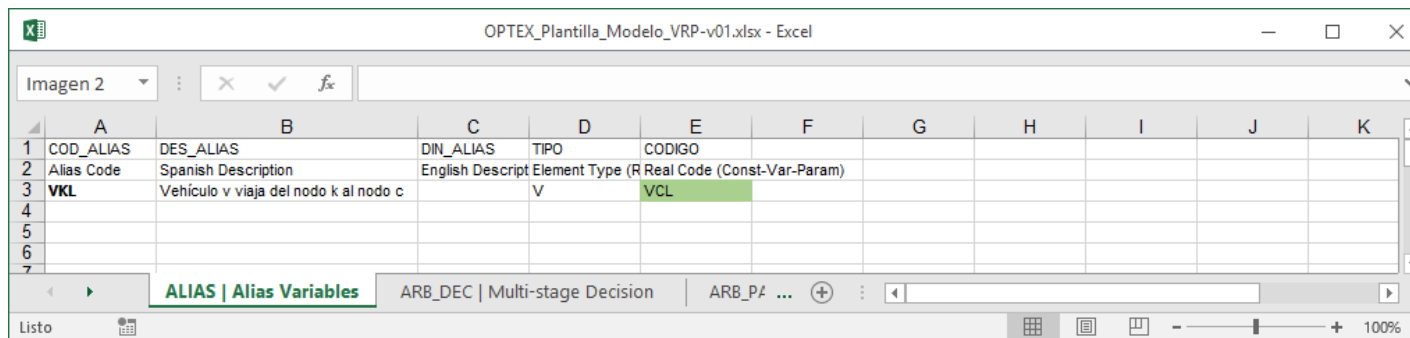
The error can be corrected directly at OPTeX-GUI interface, as shown below.



Code	Spanish Desc.	English Desc.	Element Type	Real Code
VKL	Vehículo v viaja del nodo k al nodo c		V	VCL

GENEX Super Data Window 03:37:08 p. m.

Then, the correction in the EXCEL template.

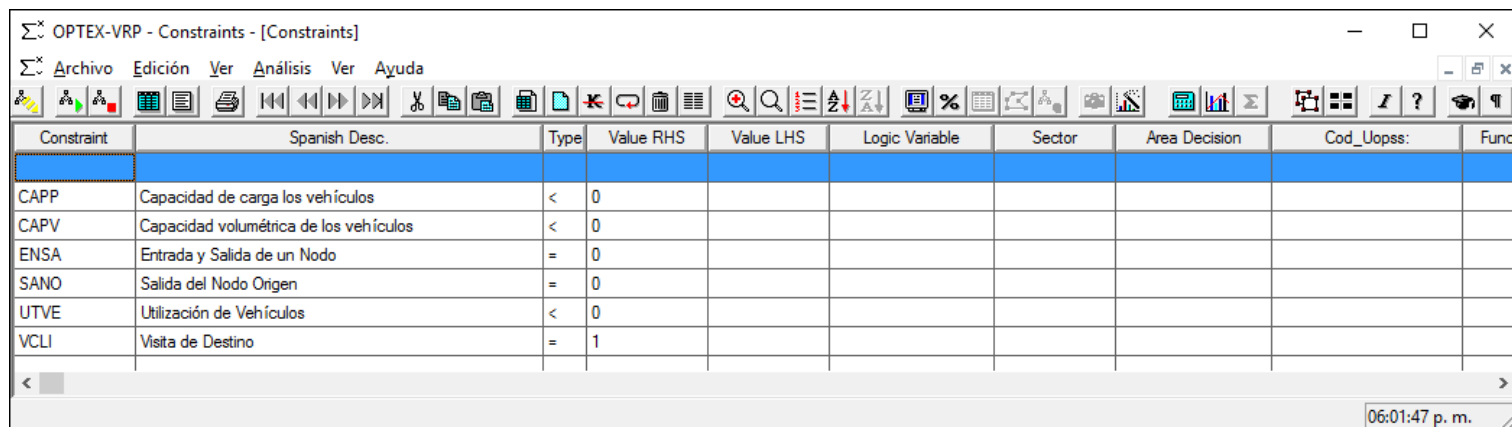


	A	B	C	D	E	F	G	H	I	J	K
1	COD_ALIAS	DES_ALIAS	DIN_ALIAS	TIPO	CODIGO						
2	Alias Code	Spanish Description	English Descript	Element Type (R	Real Code (Const-Var-Param)						
3	VKL	Vehículo v viaja del nodo k al nodo c		V	VCL						
4											
5											
6											
7											

Sheet tabs: ALIAS | Alias Variables | ARB_DEC | Multi-stage Decision | ARB_Pf ...

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) CONSTRAINTS

First error reported by OPTeX is related to the inclusion of an empty record, total or partially, in the table of constraints.



Constraint	Spanish Desc.	Type	Value RHS	Value LHS	Logic Variable	Sector	Area Decision	Cod_Uopss:	Func
CAPP	Capacidad de carga los vehículos	<	0						
CAPV	Capacidad volumétrica de los vehículos	<	0						
ENSA	Entrada y Salida de un Nodo	=	0						
SANO	Salida del Nodo Origen	=	0						
UTVE	Utilización de Vehículos	<	0						
VCLI	Visita de Destino	=	1						

06:01:47 p. m.

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) CONSTRAINTS

This can occur in any table, and is generated when the export macro included in the CSV file invalid records due to the existence of some element of "garbage", that falsely indicates the existence of information in the row, or column; This generates bugs that are resolved eliminating the empty record.

```

INPUT_CHECK_DSS_2.LOG: Bloc de notas
Archivo Edición Formato Ver Ayuda
OPTeX -> Revisando RESTRICCIONES
10:35:38 ->
10:35:38 Restricción:

ERROR 6751-> El campo asociado al RHS NO esta definido

10:35:38 Restricción:
ERROR 6751-> Secuencia: 1 - El parametro COVA tiene el indice v que no se puede resolver
10:35:38 Restricción:
ERROR 6751-> La expresion DIST no corresponde a una variable.
10:35:38 Restricción:
ERROR 6751-> Secuencia: 1 - c indice independiente del conjunto CAC no puede resolverse
10:35:38 Restricción:
ERROR 6751-> Secuencia: 1 - c indice independiente del conjunto CAC no puede resolverse
10:35:38 Restricción:
ERROR 6751-> Secuencia: 2 - El parametro NUCD no esta catalogado
10:35:38 Restricción:
ERROR 6751-> La expresion PECA no corresponde a una variable.
10:35:38 Restricción:
ERROR 6751-> Secuencia: 2 - El parametro NUCD no esta catalogado
10:35:38 Restricción:
WARNING 6751-> La variable PECA esta repetida en la ecuacion
10:35:38 Restricción:
ERROR 6751-> La expresion PECA no corresponde a una variable.
  
```

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) CONSTRAINTS

To review the constraints, first it is convenient to resolve errors in the sets, parameters, and variables, this can be done directly in the OPTEX-GUI interface or through the reprocessing of the EXCEL template. Once it has made this correction, the following image presents the bugs reported in the load of the following equations: CAPP, CAPV and UTVE.

```

OPTEX - d:\Dropbox\genex\vrp\vrpwo\CHK_RES.LOG
Fecha de creacion del archivo: 13/12/2015 - 04:05:17
04:05:18
OPTEX -> Revisando RESTRICCIONES
04:05:18 -> CAPP Capacidad de carga los vehiculos
04:05:18 ERROR 6579-> Restricción CAPP ->Codigo Indice Duplicado: v

04:05:18 Restricción: CAPP

ERROR 6751-> Secuencia: 1 - v indice dependiente del conjunto VEC no coincide con el indice c

04:05:18 -> CAPV Capacidad volumétrica de los vehiculos
04:05:18 Restricción: CAPV

ERROR 6751-> Secuencia: 1 - v indice dependiente del conjunto VEC no coincide con el indice c

04:05:18 Restricción: CAPV

ERROR 6751-> Secuencia: 2 - v indice independiente del conjunto TRK no puede resolverse

04:05:18 Restricción: CAPV

ERROR 6751-> Secuencia: 3 - La variable VCL tiene el indice v que no se puede resolver

04:05:18 -> ENSA Entrada y Salida de un Nodo
04:05:18 -> SANO Salida del Nodo Origen
04:05:18 -> UTVE Utilización de Vehículos
04:05:18 Restricción: UTVE

ERROR 6751-> Secuencia: 4 - El parametro INFI no esta catalogado

04:05:18 -> VCLI Visita de Destino
Fecha de finalización del archivo: 13/12/2015 - 04:05:18
  
```

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) CONSTRAINTS

Then will review the errors presented for each constraint.

1. CONSTRAINT: CAPP_v

$$\sum_{c \in \text{NCV}(v)} \sum_{k \in \text{TRK}(c,v)} \text{DEMP}_c \times \text{VCL}_{v,c,k} \leq \text{CAPP}_v$$

$$\forall v \in \text{VEH}$$

The reported error indicates that the index **v** is duplicated. The solution is to eliminate duplication and review leaving as the only mistake the fact that dependent index **v** of the **VEC** set not coincides with the index **c** over which the sum is defined, the right set is the **NCV**.

The screenshot shows the 'Constraints' window with the following data:

Constraint	Spanish Desc.	English Desc.	ID Constraint	ID Error	Description
CAPP	Capacidad de carga de los vehículos		6.6751	6.6751	Secuencia 1: v índice dependiente del conjunto VEC no coincide con el índice c

The screenshot shows the 'Sets' window with the following data:

Code	Spanish Description	Free Index	Dependent	Data Table	Element Field	Index Field 1	Index Field 2	Inc
NCV	Nodos n = Vehículos	v	c	VEH_NOD	COD_NOD	COD_VEH		
VEC	Vehículos -> Nodos	c	v	VEH_NOD	COD_VEH	COD_NOD		

2. CONSTRAINT: CAPV_v

$$\sum_{c \in \text{NCV}(v)} \sum_{k \in \text{TRK}(c,v)} \text{DEMP}_c \times \text{VCL}_{v,c,k} \leq \text{CAPV}_v$$

$$\forall v \in \text{VEH}$$

The reported error indicates that the index **v** has not been declared, should be included and correct the error of the **VEC** set similar to the previous case.

The screenshot shows the 'Constraints' window with the following data:

Constraint	Spanish Desc.	English Desc.	ID Constraint	ID Error	Description
CAPP	Capacidad de carga de los vehículos		6.6751	6.6751	Secuencia 1: v índice dependiente del conjunto VEC no coincide con el índice c
CAPV	Capacidad volumétrica de los vehículos		6.6751	6.6751	Secuencia 2: v índice independiente del conjunto TRK no puede resolverse
CAPP	Capacidad de carga de los vehículos		6.6751	6.6751	Secuencia 3: La variable VCL tiene el índice v que no se puede resolver

3. CONSTRAINT: UTVE_v

$$\sum_{c \in \text{NCV}(v)} \sum_{k \in \text{TRK}(c,v)} \text{VCL}_{v,c,k} - \infty \times \text{AVL}_v \leq 0$$

$$\forall v \in \text{VEH}$$

The reported error is related to the **INFI** ("infinite") parameter, which has not been declared. The solution is to declare the parameter **INFI**, as a constant **K**, whose value is defined as "default".

The screenshot shows the 'Constraints' window with the following data:

Constraint	Spanish Desc.	English Desc.	ID Constraint	ID Error	Description
SANO	Salida del Nudo Origen		6.6751	6.6751	Secuencia 4: El parámetro INFI no está declarado.

The screenshot shows the 'Parameters' window with the following data:

Code	Spanish Desc.	Unit	Type Table	Time Table	Type Series	Calculus	Field / Var /	Data Table	Cod. Upper
DIST	Distancia Nodos	km	R				DIST	NOD_NOD	
NUCA	Número de Capas del Pedido	und	R				NUCA	PED_CAJ	

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) CONSTRAINTS

The following images show the corrections made in the EXCEL template.

OPTEX_Plantilla_Modelo_VRP-v01.xlsx - Excel

C10

A	B	C	D	E	F	G	H	I	J	K	L
1	COD_RES	NIVEL	COD_IND	COD_CON							
6	ENSA	2	c	NCV		SAVO _{v,c}	Salida del Nodo Origen				
7	UTVE	1	v	VEH				$\sum_{c \in TRK(c,v)} VCL_{v,c,k} - AVL_v = 0$			
8	VCLI	1	c	DEC				$\forall v \in VEH \quad \forall c \in NOV(v)$			
9	CAPP	1	v	VEH		ENSA _{v,c}	Entrada y Salida de un Nodo				
10	CAPV	1	v	VEH				$\sum_{c \in TRK(c,v)} VCL_{v,c,k} - \sum_{c \in TRK(c,v)} VCL_{v,c,k} = 0$			
11								$\forall v \in VEH \quad \forall c \in NCV(v)$			

RES_IND | Constraint - Indexes

Archivo Inicio Insertar Diseño de página Fórmulas Datos Revisar Vista Desarrollador EQUIPO Indicar... Iniciar sesión Compartir

G1

CAMPO_3

A	B	C	D	E	F	G	H	I	J	K	L
1	COD_RES	COD_PAR	SEQ	SIGNO	CAMPO_1	CAMPO_2	CAMPO_3	COD_VAR			
17	CAPP		1	+	S	c/NCV					
18	CAPP		2	+	S	k/TRK				DEMP _c	Demanda en Peso
19	CAPP		3	+	S	VCL					Demanda del nodo expresada en kilogram
20	CAPV		1	+	S	c/NCV					
21	CAPV		2	+	S	k/TRK					
22	CAPV		3	+	S	VCL					$DEMP_c = \sum_b c_b$

ECUACION | Equations

Archivo Inicio Insertar Diseño de página Fórmulas Datos Revisar Vista Desarrollador EQUIPO Indicar... Iniciar sesión Compartir

C1

COD_UNI

A	B	C	D	E	F	G	H	I	J	K	
1	COD_PAR	DES_PAR	COD_UNI	COD_TDB	DEFAULT	CAMPO_P	COD_DB	COD_UNT	COD_TSD	COD_TPD	COD_UOPS
11	CVIA	Costo de Viaje Entre Nodos	\$	C							
12	DEMP	Demanda en Peso	kg	C							
13	DEMV	Demanda en Volumen	m3	C							
14	NUCD	Cajas Totales para el cliente	und	C							
15	INFI	Infinito		K	1000						

PARAMETRO	DESCRIPCION
CAPP _v	Capacidad del Vehículo en Peso Capacidad en peso del vehículo medida en kilogramos
CAPV _v	Capacidad del Vehículo en Volumen Capacidad volumétrica del vehículo medida en metros cúbicos
CVIA _v	Costo Variable de Utilizar un Vehículo

MODPROCO | Models - Problems -

PAR_IND | Parameter - Indexes

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) OBJECTIVE FUNCTIONSs

Bellow the errors reported by OPTeX for objective functions.

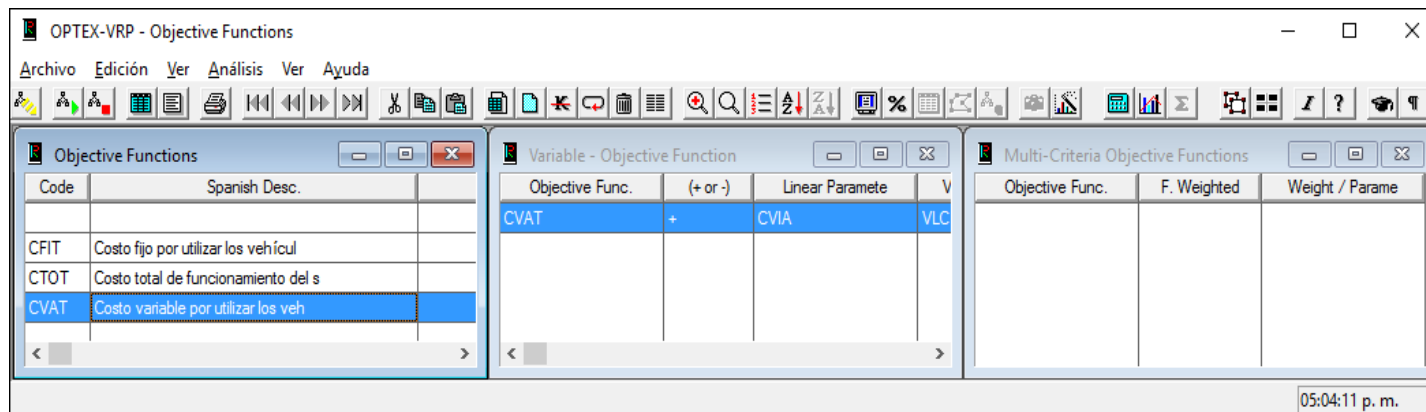
```

INPUT_CHECK_DSS_2.LOG: Bloc de notas
Archivo Edición Formato Ver Ayuda

10:35:40
OPTeX -> Revisando FUNCIONES OBJETIVO
10:35:40 ->
10:35:40 ERROR-> Funcion Objetivo Tipo : Equivocado. Debe ser: MUL, SIM o FRA

10:35:40 -> CFIT Costo fijo por utilizar los vehicul
10:35:40 -> CTOT Costo total de funcionamiento del s
10:35:40 -> CVAT Costo variable por utilizar los veh
10:35:40 ERROR-> Funcion Objetivo CVAT Variable: VLC NO esta catalogada
  
```

The first reported error is due to the blank line which is imported from the CSV file and the second to an error in the name/code of the VCL variable that was loaded as VLC



The screenshot shows the OPTeX-VRP - Objective Functions window with three data tables:

Code	Spanish Desc.
CFIT	Costo fijo por utilizar los vehicul
CTOT	Costo total de funcionamiento del s
CVAT	Costo variable por utilizar los veh

Objective Func.	(+ or -)	Linear Paramete	V
CVAT	+	CVIA	VLC

Objective Func.	F. Weighted	Weight / Parame

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) OBJECTIVE FUNCTIONS

Bellow the EXCEL template corrected

FUNCIÓN OBJETIVO	DESCRIPCIÓN - ECUACIÓN	UNIDAD
CFIT	Costo fijo por utilizar los vehículos Corresponde a la suma de los costos fijos asociados a los vehículos que se activan	\$

The spreadsheet also contains the following data in rows 1-4:

COD_FOB	SIGNO	COD_PAR	COD_VAR	COD_PAR1	COD_VAR1
Objective Functi	Sign (+ or -)	Linear Paramete	Linear Variable	Quadratic Paran	Quadratic Variable Code
CFIT	+	CFU	AVL		
CVAT	+	CVIA	VCL		

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) PROBLEMS

Related problems are associated with the inclusion of NOCL restriction that it is not considered in the formulation of the model. The solution in this case will be to remove NOCL from the formulation.

```

OPTEX - d:\Dropbox\genex\vrp\vrpwo\CHK_PRO.LOG
Fecha de creación del archivo: 13/12/2015 - 05:09:17
05:09:17
OPTEX -> Revisando PROBLEMAS
05:09:17 -> VRP Ruteo Vehículos (VRP)
05:09:17 ERROR 6565-> Problema: VRP : La restricción NOCL NO está catalogada

05:09:17 -> VRP2C Ruteo Vehículos (VRP) - Peso + Volumen
05:09:17 ERROR 6565-> Problema: VRP : La restricción NOCL NO está catalogada

Fecha de finalización del archivo: 13/12/2015 - 05:09:17
    
```

The table that defines the problem remains as shown below.

VRP TYPE PROBLEMS				
CODE	DESCRIPTION	PROBLEM FORMAT	CONSTRAINTS	
			BASICS	WEIGHT VOLUME
VRP	Routing vehicle (VRP)	MIP	ENSA UTVE VCLI SANO	
VRP2C	Routing vehicle (VRP) - Weight + Volume	MIP		CAPP CAPV

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) PROBLEMS

Related problems are associated with the inclusion of NOCL restriction that it is not considered in the formulation of the model. The solution is this case will be removed NOCL from the formulation.

```

OPTEX - d:\Dropbox\genex\vrp\vrpwo\CHK_PRO.LOG
Fecha de creacion del archivo: 13/12/2015 - 05:09:17
05:09:17
OPTEX -> Revisando PROBLEMAS
05:09:17 -> VRP Ruteo Vehículos (VRP)
05:09:17 ERROR 6565-> Problema: VRP : La restriccion NOCL NO esta catalogada

05:09:17 -> VRP2C Ruteo Vehículos (VRP) - Peso + Volumen
05:09:17 ERROR 6565-> Problema: VRP : La restriccion NOCL NO esta catalogada

Fecha de finalización del archivo: 13/12/2015 - 05:09:17
    
```

The following image shows corrections in the EXCEL template.

CÓDIGO	DESCRIPCIÓN	FORMATO PROBLEMA	RESTRICCIÓN	
			BÁSICAS	PESO VOLUMEN
VRP	Ruteo Vehículos (VRP)	MIP	ENSA	
VRP2C	Ruteo Vehículos (VRP) - Peso + Volumen	MIP	UTVE	
			NOCL	CAPP
			VCLI	CAPV

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) MODELS

The models uploaded to the MMIS are below, it does not have errors.

OPTEX-VRP - Mathematical Models

Archivo Edición Ver Análisis Ver Ayuda

Mathematical Models

Code	Spanish Desc.
VRP	Ruteo Vehículos (VRP)
VRP2C	Ruteo Vehículos (VRP) - Peso + Volumen

Model - > Problems

Model	Problem	Logic Variable	Objective Func.	Optimize Type
VRP2C	VRP2C			

06:19:07 p. m.

CHECKING THE MATHEMATICAL MODEL INFORMATION SYSTEM (MMIS) DECISION SUPPORT SYSTEMs

Finally, a system of decision-support containing the two formulated models can comply. So it can be loaded into the EXCEL template in the DSS and DSS_MOD sheets.

A	B	C	D	E	F	G
1	COD_DSS	DES_DSS	DIN_DSS	COMENTARIO		
2	DSS_Code	Spanish Description	English Description	Comments		
3	DSSVRP	DSS Vehicle Routing Problem				
4						
5						

A	B	C	D	E	F	G	H	I
1	COD_DSS	COD_MOD	SEQ	COD_ARD	COD_HOR	COD_FOB	COD_TOP	POS_
2	Decision Suppo	Model Code	Order	Decision Tree C	Planning Horizor	Objective Functi	Type Code	Optir Functi
3	DSSVRP	VRP						
4	DSSVRP	VRP2C						
5								

The following image shows the structure of the DSS in OPTeX-MMIS

Decision Support Systems - Models

DSS	Model	Order	Decision Tree	Horizon	Objective Func.	Ty
DSSVRP	VRP	0				
DSSVRP	VRP2C	0				

Decision Support Systems

Code	Spanish Desc.	English Desc.
DSSVRP	DSS Vehicle Routing Problem	

07:16:11 p. m.

SERVICES OFFERED BY OPTEX-GUI

OPTEX-GUI provides several services to support the mathematician modeler in the implementation of the models; to access to these services the user must click the right bouton mouse in the window of exploration of the mathematical models area. These services are presented in the following image and correspond to the third group of services:

Optimizar	
Importar Tablas Sistema Información Industrial (SIDI)	
Generar Tablas Dependientes SIDI	
Chequear Integridad SIDI	
Exportar Sistema Información Industrial (SIDI a EXCEL)	
Explorar Area de Datos	
Exportar Tablas SQL a DBF	
Explorar Tablas	F3
Importar Sistema Información Modelos Matemáticos (SIMM)	
Generar Documento Formulación (RTF)	
Chequeo Estructura Sistema Soporte de Decisiones (SSD)	
Exportar Sistema Información Modelos Matemáticos (SIMM a EXCEL)	
Explorar Área Modelos Matemáticos	
Generar Documento Modelo de Datos (RTF)	
Explorar Modelo Datos - Interfaz GUI	
Generación Estructuras OPTEX-GUI	
Explorar Series Historicas	
Explorar Anomalias	

SERVICES OFFERED BY OPTeX-GUI

IMPORT MMIS

This service has already been presented and was used for massive loads of the MMIS from files in CSV format.

GENERATION ALGEBRAIC FORMULATION IN RTF DOCUMENT

Generates a RTF document with all the algebraic formulation. This document can be edited with text editors such as MS-Word programs and other similar. The generated document can be downloaded from the URL:

http://www.doanalytics.net/Documents/INPUT_CHECK_DSS_2.LOG

CHECK MMIS STRUCTURE

This service has been used in the process of massive load of the MMIS which includes the check of the structure, the report is similar to those previously presented.

EXPORT OF THE MMIS TO EXCEL FILES

This service is in the process of adjustment.

SERVICES OFFERED BY OPTEX-GUI

EXPLORATION OF THE MMIS

It allows to directly explore all tables that comprise the MMIS and modify its content if deemed suitable, such as shown in the following image.

The screenshot shows the OPTeX-VRP DB Explorer interface. On the left is a tree view of the database structure. The main area displays a table with the following columns: Código, Descripción, I.I., I.D., Tabla Datos, C. Elemento, CampoIndic..., Oper..., Conjunto 1, and Conjunto 2. A context menu is open over the table, listing actions such as 'Añadir Registro', 'Editar Registro', 'Duplicar Registro', 'Eliminar Registro', and 'Eliminar Registros Visibles DataLVContextRoot'.

Código	Descripción	I.I.	I.D.	Tabla Datos	C. Elemento	CampoIndic...	Oper...	Conjunto 1	Conjunto 2
CAP	Cajas -> Pedido	w ...	b	PED_CAJ	COD_CAJ	COD_PED	-		
DEC	Destinos c	* ...	c	NODOS	COD_NO...		F		
NCV	Nodos c <- Vehículos	v ...	c	VEH_NOD	COD_NO...	COD_VEH	-		
NOC	Nodo Origen -> Nodo Destino	k ...	c	NOD_NOD	COD_NO...	COD_NOD1	F		
NOD	Nodos	* ...	c	NODOS	COD_NO...		-		
NOV	Nodo Origen <- Vehículos	v ...	c	NOR_VEH	COD_NO...	COD_VEH	-		
DEK	Destinos k	* ...	k	NODOS	COD_NO...		F		
NKV	Nodos k <- Vehículos	v ...	k	VEH_NOD	COD_NO...	COD_VEH	-		
NOK	Nodo Destino -> Nodo Origen	c ...	k	NOD_NOD	COD_NO...	COD_NOD	F		
VEC	Vehículos -> Nodos	c ...	v	VEH_NOD	COD_VEH	COD_NOD	-		
VEH	Vehículos	* ...	v	VEHICULOS	COD_VEH		-		
VEK	Vehículos -> Nodos Destino k	k ...	v	VEH_NOD	COD_VEH	COD_NOD	-		
PEC	Pedidos -> Clientes	c ...	w	PEDIDOS	COD_PED	COD_NOD	-		
CAC	Cajas que deben ser transportadas al nodo	c ...	b				S	PEC	CAP
TRC	Caminos Sobre los Cuales Puede Transitar el Vehículo	k.v ...	c				I	NCV	NOC
DKC	Destinos k -> Destino c	c ...	k				I	DEK	NOK
TKD	Caminos Sobre los Cuales Puede Transitar el Vehículo (Destinos)	c.v ...	k				I	TRK	DEK
TRK	Caminos Sobre los Cuales Puede Transitar el Vehículo	c.v ...	k				I	NKV	NOK
IVET	Vehículos que Pueden Transitar por el Camino	c.k ...	v				I	VEK	VEC



Analytics

"the computer-based mathematical modeling is the greatest invention of all times"

Herbert Simon
First Winner of Nobel Prize in Economics (1978)

"for his pioneering research into the decision-making process within economic organizations"