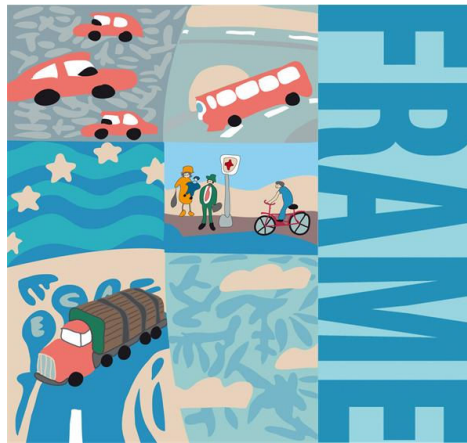# FRAME Forum

European ITS Framework Architecture

FRAME Selection Tool

User Manual

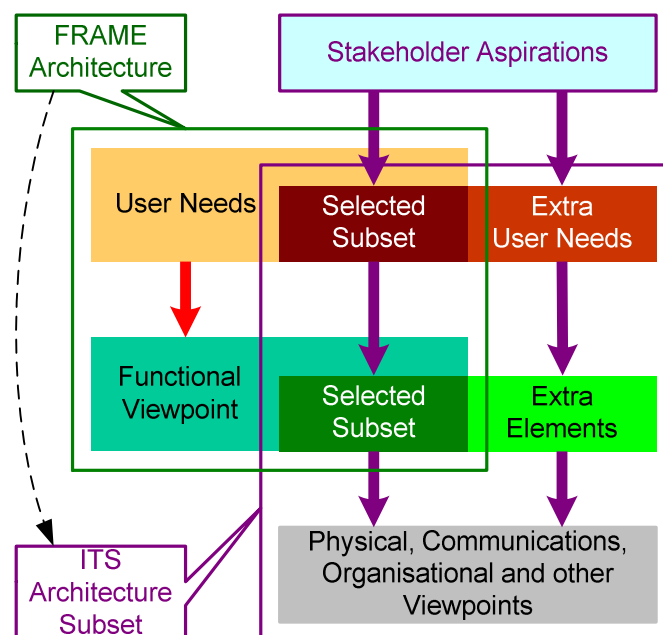(for Version 3)

Table of Contents

1 Background

1.1 Introduction

The FRAME Selection Tool has been created to enable users of the European ITS Framework (FRAME) Architecture to:

- Create their own Functional Viewpoints subsets of the FRAME Architecture;

- Create one or more Physical Viewpoints of each Function Viewpoint subset;

- Create one or more Organisational Viewpoints of each Function Viewpoint subset;

The process of creating an ITS Architecture as a subset of the FRAME Architecture is summarised in Figure 1. This shows that the normal procedure is to select a subset of the User Needs, which will provide guidance as to which Functions will be required to create the Functional Viewpoint subset. Although the FRAME Architecture contains most of the User Needs and Functionality associated with ITS within the European Union, there may be occasions when a few of the required features are missing. The details on how to add them can be found in the Selection Tool Reference Manual[1]. This, and information on the FRAME Architecture in general can be found in reports, articles and papers on the FRAME website www.frame-online.net,

Figure 1 – Creating an ITS Architecture Subset

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[1] Although the Reference Manual was written for Version 2 of the Selection Tool, most of its contents are still valid since no feature has been removed – see Section 1.3.

1.2   Data Flow Modelling[2]

Context Diagram

Data Flow modelling uses Data Flow Diagrams to show how data flows through a sequence of processing steps, and are an intuitive way of showing how data is processed by a system. For a large model such as the FRAME Architecture it is necessary to describe the system in a series of hierarchical diagrams, in which higher-level Functions are split into a number of lower-level Functions. There are a few simple and obvious rules that govern their construction.

The top level diagram is called the Context Diagram (see Figure 2). The System is contained within its system boundary and comprises all the functionality etc. necessary to perform the tasks of that system. Responsibility for The System lies with its developer(s), owner(s) and operator(s). Users of The System provide it with input data and make use of the output data. Because the sources and users of the input and output data respectively are where the data flow diagram(s) finish, or terminate, they are known as Terminators.
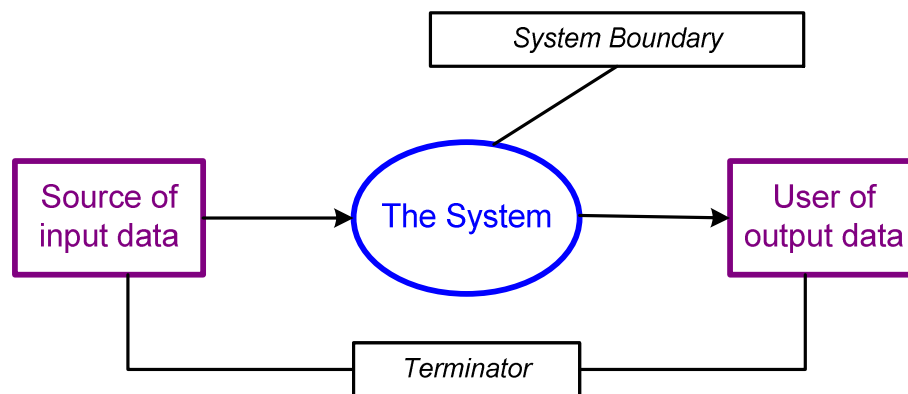

Figure 2 – Basic Context Diagram

The FRAME Architecture has a large number of Terminators, some of which are examples of the same type. These FRAME Terminators have been split into a number of different Actors, e.g. the Terminator *Driver*, has Actors that include *Public Transport Driver*, *Emergency Vehicle Driver* and *Freight Vehicle Driver*. It is thus possible to refer to a complete set of Actors by using a single Terminator, e.g. to output information to all *Drivers*, rather than to *Drivers* of a particular type of vehicle.

The System may be described using a number of different Viewpoints, in particular the Functional Viewpoint, the Physical Viewpoint, the Communication Viewpoint and the Organisational Viewpoint. The Selection Tool supports the creation of the Functional, Physical and Organisational Viewpoints, and provides some data from which the Communications Viewpoint can be created.

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[2] Descriptions of the Data Flow Model can be found in a number of books on Software Engineering, e.g. Sommerville I, *Software Engineering (8th Ed)*, Addison Wesley, 2007, ISBN 978-0-321-31379-9

Functional Viewpoint

A Functional Viewpoint (sometimes called a Logical Viewpoint) shows the functionality that will be required to fulfil the User Needs, and hence the Stakeholder Aspirations. It is shown using Data Flow Diagrams that contain Functions and Data Stores, and the Data Flows that pass data between them (see Figure 3). Each of these is provided with its own description which, in the case of functions, includes statements explaining what they do, e.g. collect data from a source outside the Architecture. The Functional Viewpoint of the complete FRAME Architecture can be seen using the Browsing Tool (www.frame-online.net). New Functions etc. are only needed for Stakeholder Aspirations that require new User Needs to be added (see Selection Tool Reference Manual [1]).
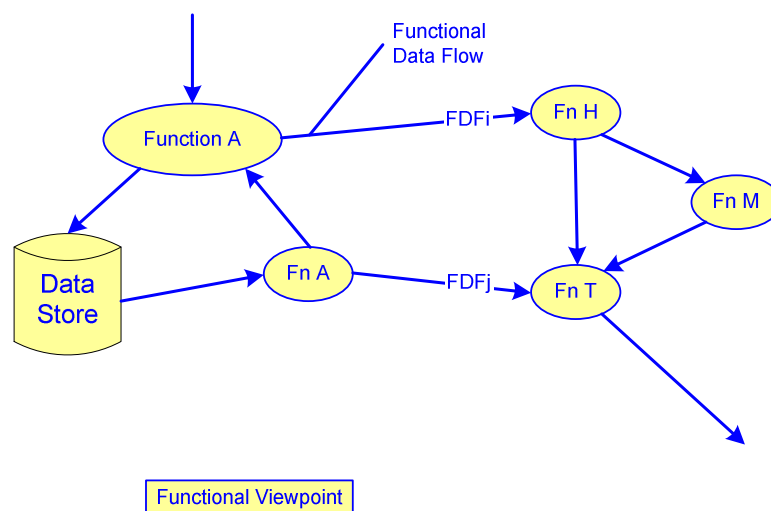
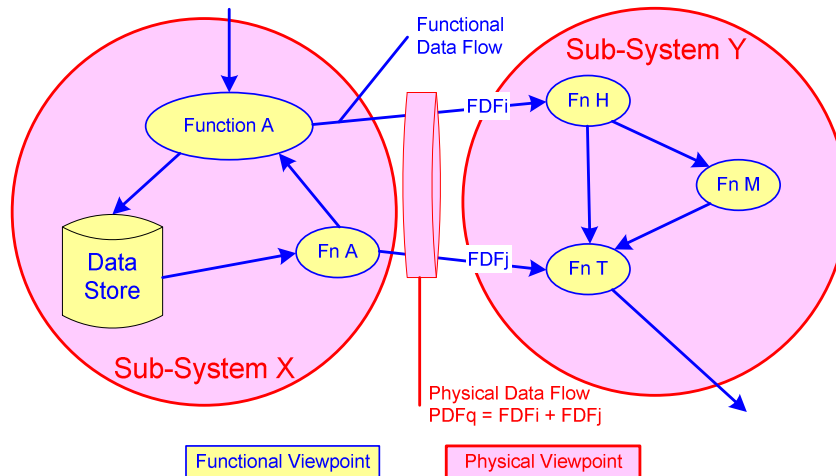**Figure 3 – Example Functional Viewpoint**

Since the FRAME Architecture comprises a Functional Viewpoint that satisfies all of its User Needs, and hence most European ITS, it is only necessary to select the sub-set that serves the User Needs that have been mapped to the specific Stakeholder Aspirations for the region in question.

Physical Viewpoint

Once the Functional Viewpoint is complete, it is normal to allocate each item of functionality to a location, either within a sub-system (see Figure 4), or within a module that is part of a sub-system.

Once this has been completed the component (sub-system or module) specifications can be created from the definitions of the functions and data stores within them and can be included in the tenders for their procurement. They can also provide the input to any OO methodologies that might be used for the detailed design part of the systems engineering lifecycle.

The data that flows between the Sub-Systems (e.g. the Physical Data Flow in Figure 4) provides a starting point for an analysis of the communications requirements (i.e. the Communications Viewpoint).

Figure 4 – Example Functional and Physical Viewpoints

Organisational Viewpoint

The Organisational Viewpoint is created in a similar manner to the Physical Viewpoint (indeed on some occasions it may look identical), with the exception that instead of dividing the Functional Viewpoint between Sub-Systems, it is divided between Organisations.

1.3   The FRAME Selection Tool V3

Users of Version 2 of the FRAME Selection Tool will find Version 3 to be very similar, with the following principal exceptions:

- Organisational Viewpoints can be created in a manner that is analogous to the way that Physical Viewpoints are created.

- Sometimes it has been found necessary to put the same Function into more than one Sub-System/Module/Organisation; it is now possible to duplicate a Function or a Data Store (and (some of) it's associated Data Flows), and to give it a unique name.

- The information in some of the windows is more helpful, and the windows themselves can be re-sized;

- It is now possible to go both *backwards* and forwards through the sequence of windows.

- The handling of Reports is more user friendly.

2 Overview of the Selection Tool

The FRAME Selection Tool takes the user through a number of stages as shown in Figure 7. It is first necessary to create a Functional Viewpoint sub-set of the FRAME Architecture. It is then possible to create as many Physical and/or Organisational Viewpoints using that Functional Viewpoint sub-set as are required. However, once the creation of the first Physical or Organisational Viewpoint has been started, it is no longer possible to modify the corresponding Functional Viewpoint. Should an attempt be made to do so, the Tool will offer to create a "clone" (copy) of that Functional Viewpoint, which is given a different name.

All Viewpoints are held within the same Microsoft® Access® database as the original FRAME Architecture and so it is always advisable to keep a "pure copy" of the original database in case of accidents. The Tool will work with databases created with all (known) versions of Microsoft® Access®. The latest version of the database is always available from the FRAME website at www.frame-online.net .

2.1 Manipulation of the Screens

Whilst the Window for the Selection Tool itself starts as a "maximum" screen, each stage has its own sub-screen, which can be varied in size in the usual manner. Movement between the sub-screens (or stages) shown in Figure 7 is performed using the "OK" button to move forwards, or the "Back" button to move backwards. Work can be suspended at any time using the "Quit" button.
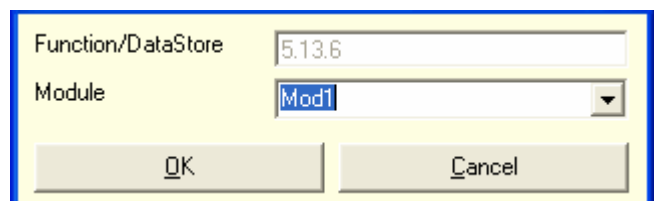
Selection Screens

Figure 5 shows part of a Selection Screen; the items on the left are available for selection, and those on the right have been selected. They are selected or de-selected using the "Add" or "Remove" buttons respectively. The identification of each element is done using either a mouse click, or with up/down arrows and the space bar.
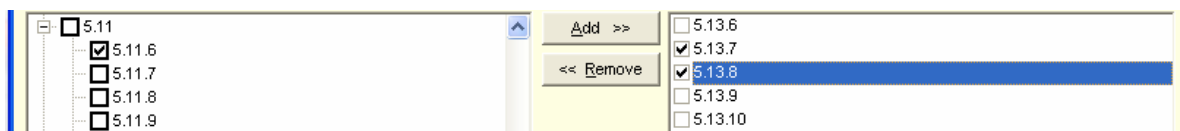
Figure 5 – Part of a Selection Screen
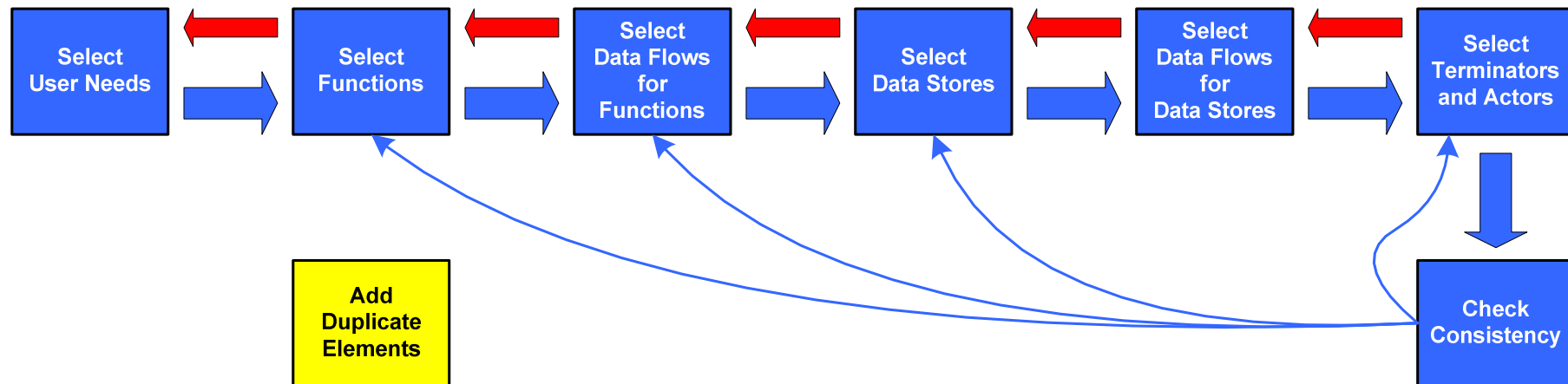
Allocation Screens

Figure 6 shows part of an Allocation Screen; the items available for allocation are shown in the drop-down list. The allocation is done using either a mouse click, or with up/down arrows and the Enter key.
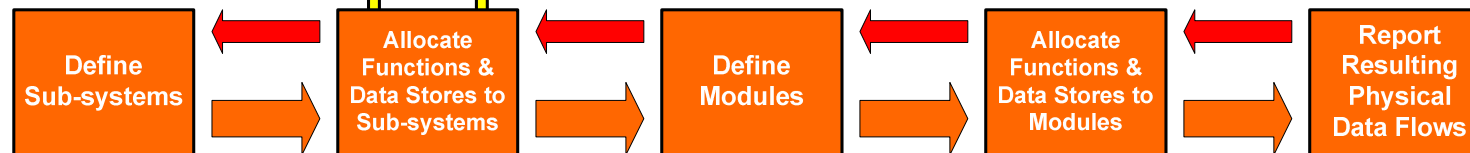

Figure 6 – Part of an Allocation Screen

Functional Viewpoint

Select User Needs	Select Functions	Select Data Flows for Functions	Select Data Stores	Select Data Flows for Data Stores	Select Terminators and Actors

Check Consistency

Add Duplicate Elements

Physical Viewpoint

Define Sub-systems	Allocate Functions & Data Stores to Sub-systems	Define Modules	Allocate Functions & Data Stores to Modules	Report Resulting Physical Data Flows

Organisational Viewpoint

Define Organisations	Allocate Functions & Data Stores to Organisations	Report Resulting Organisation Data Flows

Figure 7 – The Stages of the Selection Tool
Use the "OK" button to move forwards, and the "Back" button to move backwards

2.2 Use of the Commands

Choosing a Data Base
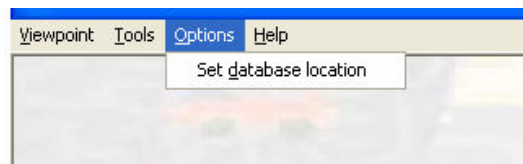
Figure 8 – Choosing a Data Base

The data that represents the FRAME Architecture is held within a Microsoft® Access® database, which is available form the FRAME website at www.frame-online.net . This should be downloaded and stored in a directory on your computer, and the "Set database location" command (see Figure 8) provides the mechanism to inform the Selection Tool where it is.

Choosing a Viewpoint
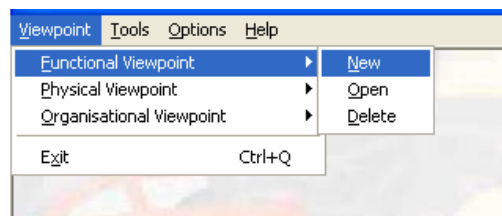
Figure 9 – Choosing a Viewpoint

The viewpoint to be created, edited or deleted is chosen from the "Viewpoint" Command (see Figure 9). New Functional Viewpoints require a name and an optional description to be given. New Physical and Organisation Viewpoints will also require the name of the Functional Viewpoint on which they will be based.

Reports
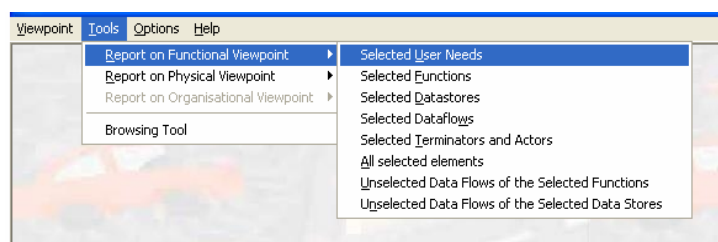
Figure 10 – Using the Tools to get Reports

Figure 10 shows that a number of reports are available which list the various elements that have been selected in the ITS Architecture sub-set that is currently open. Each report is written as an Excel CSV file, which can be opened from the within the Selection Tool as soon as it has been created. It is normally necessary to modify the width of the columns in order to make the report fully usable.

2.3   User Needs and Functions

Cross References between User Needs and Functions

Although each User Need is cross-referenced to one or more functions, it is important to note that:

- The cross-references that have been made between the User Needs and the Functions only indicate the *primary functions* required to satisfy each User Need[3];

- Some primary functions are different ways of satisfying the same User Need, and they may not all be required;

- The cross-references are only one way: thus, when a function is selected that is not one of the primary functions for the selected set of User Needs, its corresponding User Need(s) will not be added automatically to that set.

  o Thus, if you do not select any User Needs and proceed directly to the selection of Functions, the list of selected User Needs will always remain empty.

Functional Viewpoint – First and Subsequent Passes

When creating a Functional Viewpoint subset the Tool distinguishes between the First Pass and the Subsequent Passes through the stages shown in Figure 7 whenever User Needs have been selected in the first stage.

During the First Pass:

- **Selection of Functions** – the Functions that are offered on the left hand side of the screen are only those that are cross-referenced to the selected User Needs.

- **Selection of Data Stores** –the Data Stores that are offered are only those which are associated with the Data Flows that have been selected so far.

- **Selection of Terminators** – the Terminators that are offered are only those which are associated with the Data Flows that have been selected so far.

During the subsequent passes:

- **Selection of Functions** – the remaining un-selected Functions are offered so that the secondary functions that provide data to, or process data from, the primary functions can be selected. Which ones need to be selected will depend on the detailed requirements of the subset, and reference should be made to the complete FRAME Architecture using the Browsing Tool (www.frame-online.net) in order to identify them.

- **Selection of Data Stores** – the remaining un-selected Data Stores are offered.

- **Selection of Terminators** – the remaining un-selected Terminators are offered.
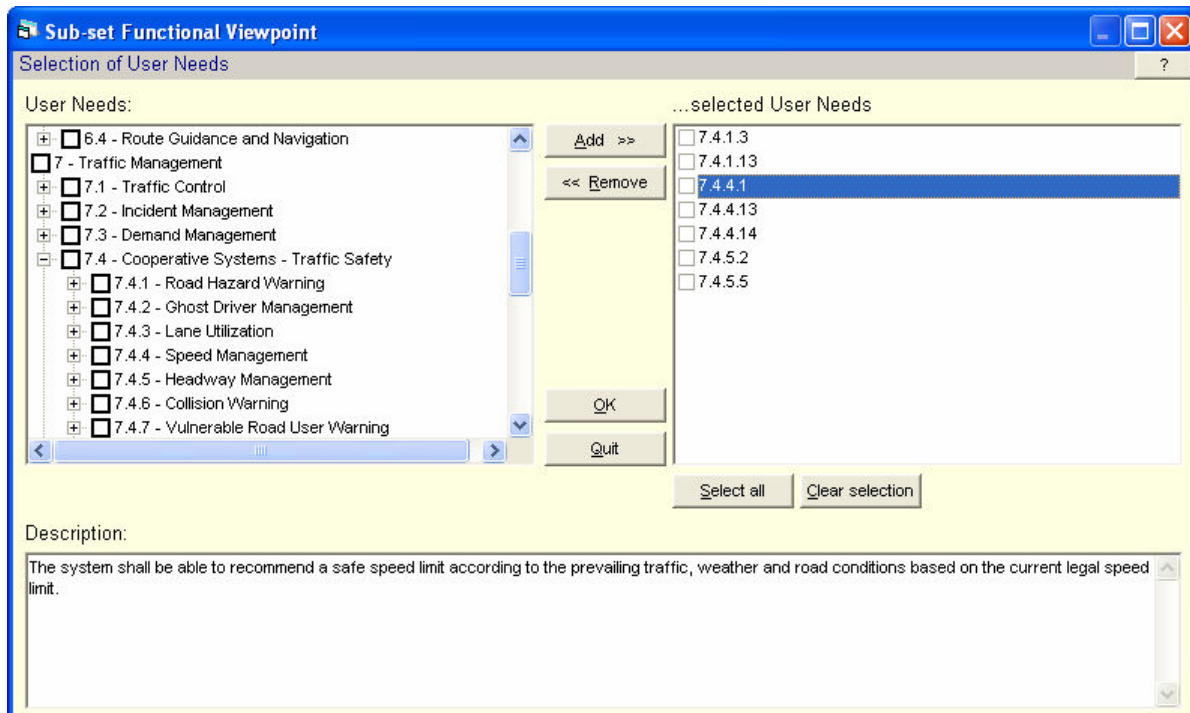
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[3] The alternative approach, of listing every possible function that might be associated with each User Needs, was found to be unworkable as far too many optional functions would be offered.

3   Creating a Functional Viewpoint Sub-set

3.1   Selection of User Needs

Objective

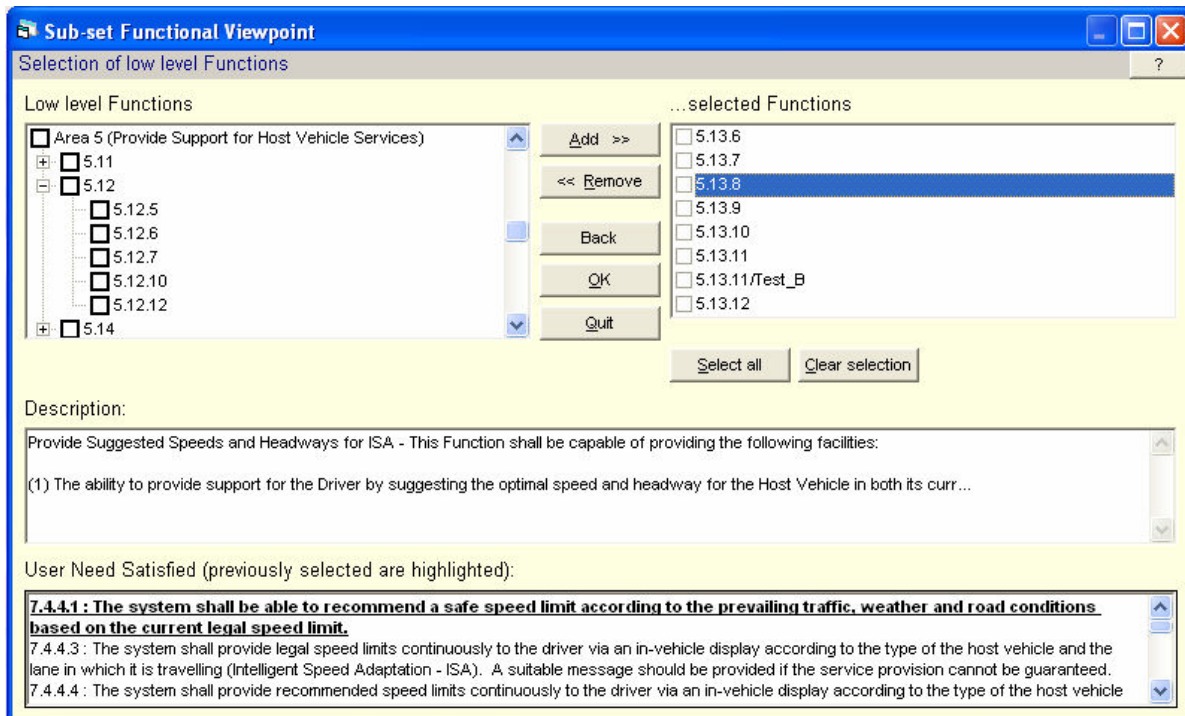To select/record the User Needs that correspond to the Stakeholders Aspirations for the region or project.

Explanation of the Screen

All the User Needs in the FRAME Architecture appear initially on the left hand side of the screen, and those that are selected are then moved to the right hand side. When a User Need number is highlighted, its description is shown in the text box at the bottom.

Hint(s)

- Please read Section 2.3.

- Since you can only see the full description of one User Need at a time, this screen is not really suitable for making the initial choice of the entire sub-set of all the User Needs you want. You can find tables of the User Needs, which are much easier to study en masse, on the FRAME website at www.frame-online.net . Once you have chosen the sub-set you require, you can then record your choice using this screen.

- On rare occasions, a few people do not wish to select User Needs. If you are one of them, then please go directly to the next screen using the "OK" button – but you may find the next stage more difficult to do!

3.2 Selection of Low-Level Functions

Objective

To select the Functions which, together, satisfy the User Needs, and hence the Stakeholder Aspirations. See also Section 2.3.

Explanation of the Screen

First Pass – all the Functions which help to satisfy one or more of the User Needs that have been selected in the previous screen are displayed on the left hand side of the screen.

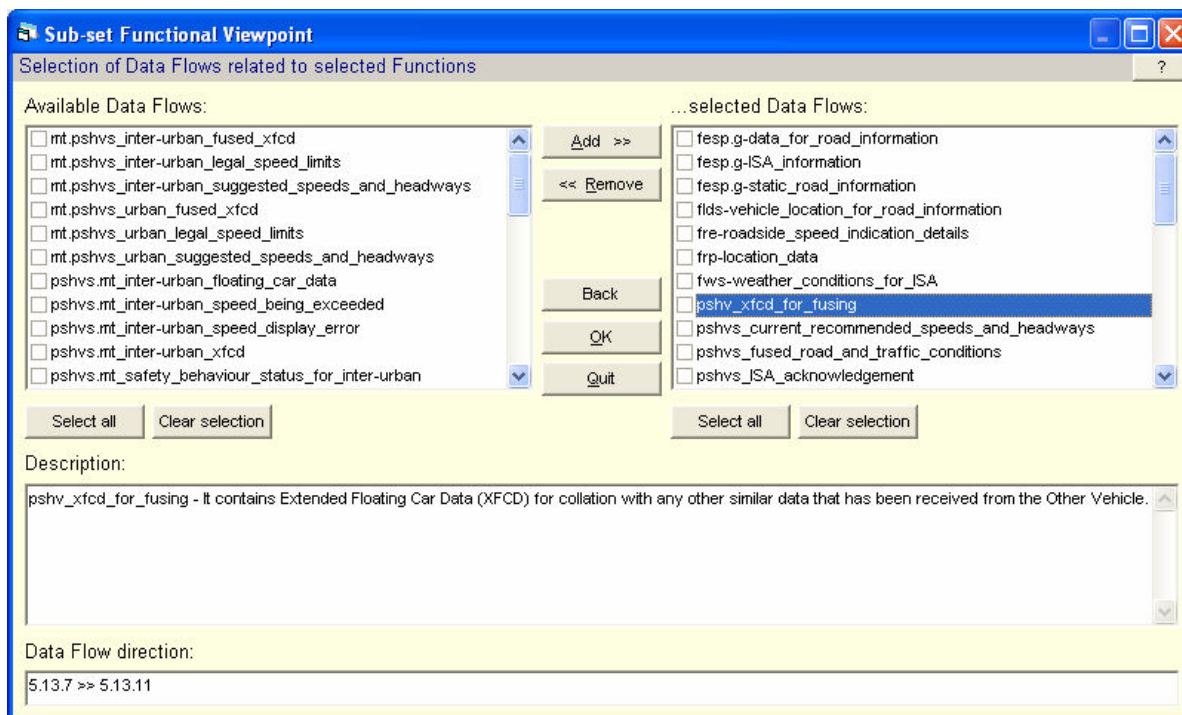*Remaining Passes* – all un-selected Functions are displayed on the left hand side of the screen.

Those Functions that are selected are then moved to the right hand side. When a Function number is highlighted, its description is shown in the upper text box at the bottom of the screen. The lower text box displays the Users Needs that this Function helps to satisfy, and those that were selected on the previous screen are highlighted.

Hint(s)

- *First Pass* – you must remember that the allocation of User Needs to Functions within the FRAME Architecture is not an exact science. It is therefore necessary to confirm that you do really want each of the Functions that have been offered.

- *Remaining Passes* – the allocation of User Needs to Functions indicates the primary functions that will perform the task mentioned in the User Needs – only. It is therefore necessary to add the functions that are required to provide the data for the task, and to use the results of the task. This process is done in conjunction with the following two *Selection of Data Flows* screens.

3.3 Selection of Data Flows Related to Selected Functions

Objective

To select the required Data Flows associated with the selected Functions.
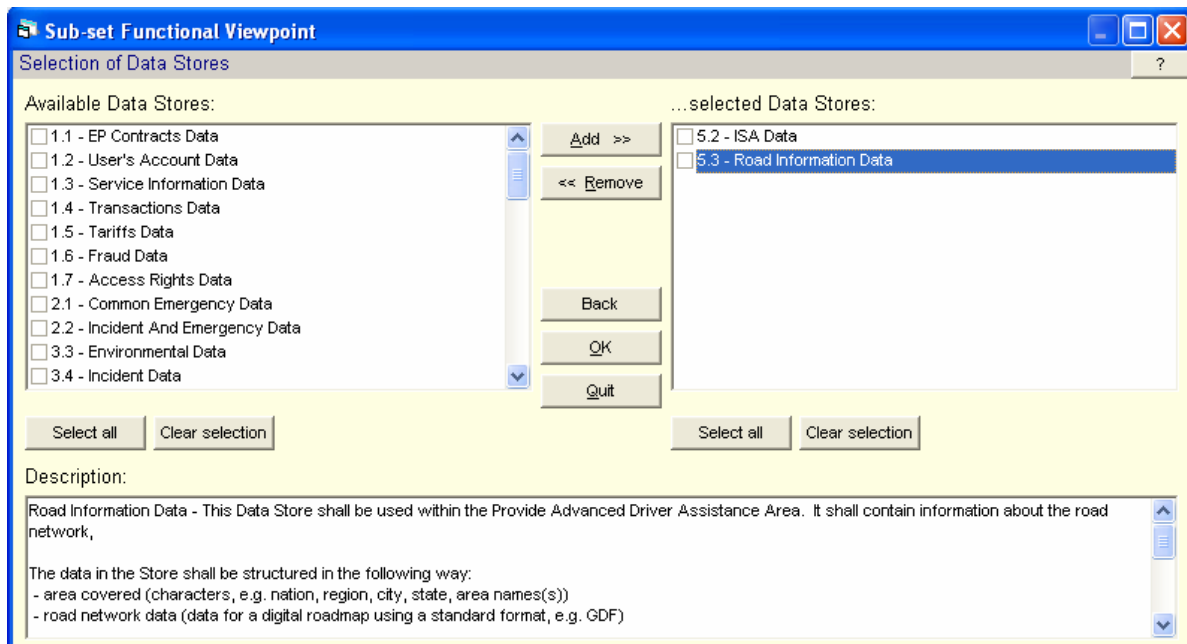
Explanation of the Screen

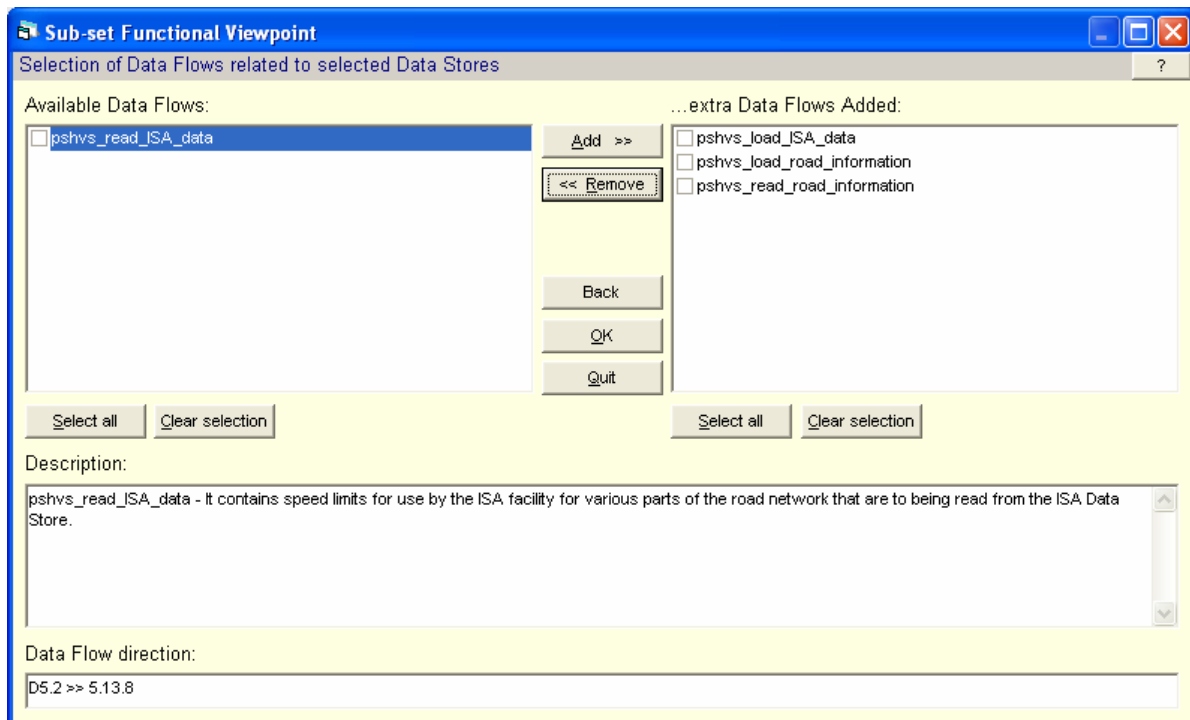All the Data Flows related to the Functions that have been selected in the previous screen appear initially on the left hand side of the screen, and those that are selected are then moved to the right hand side. When a Data Flow is highlighted, its description is shown in the upper text box at the bottom of the screen, and its source and sink are shown in the lower text box

Hint(s)

- You need to understand how the Data Flows relate to the Functions, and you use the Browsing Tool (from www.frame-online.net) to do this.

- The Functions are described in a general manner, and do not always require all their Data Flows. Many Data Flows carry data of the same type of data from/to different parts of the Architecture and so it is only necessary to select those Data Flows that are relevant to your Stakeholder Aspirations.

- Your choice of Data Flows is as important as your choice of Functions, and should be done with care.

- Do not be surprised if this screen takes some time to complete. Remember that the "Quit" command will store the selection you have made so far.

3.4   Selection of Data Stores Related to Selected Data Flows

Objective

To select the Data Stores required for the ITS Architecture sub-set. See also Section 2.3.

Explanation of the Screen

First Pass – all the Data Stores which are associated with the Data Flows that have been selected in the previous screen are displayed on the left hand side of the screen.

Remaining Passes – all un-selected Data Stores are displayed on the left hand side of the screen.

Those Data Stores that are selected are then moved to the right hand side. When a Data Store is highlighted, its description is shown in the text box at the bottom of the screen.

Hint(s)

- You need to understand how the various Data Stores and Functions relate to each other, and you use the Browsing Tool (from www.frame-online.net) to do this.

3.5   Selection of Data Flows Related to Selected Data Stores

Objective

To select the required Data Flows associated with the selected Data Stores.

Explanation of the Screen

All the Data Flows related to the Data Stores that have been selected in the previous screen appear on this screen. Those on the left hand side of the screen have not been selected, and those that are selected are shown on, or moved to, the right hand side. When a Data Flows is highlighted, its description is shown in the upper text box at the bottom of the screen, and its source and sink are shown in the lower text box

Hint(s)

- You need to understand how the Data Stores relate to the Functions, and you use the Browsing Tool (from www.frame-online.net) to do this.

3.6 Selection of Terminators/Actors Related to Selected Data Flows
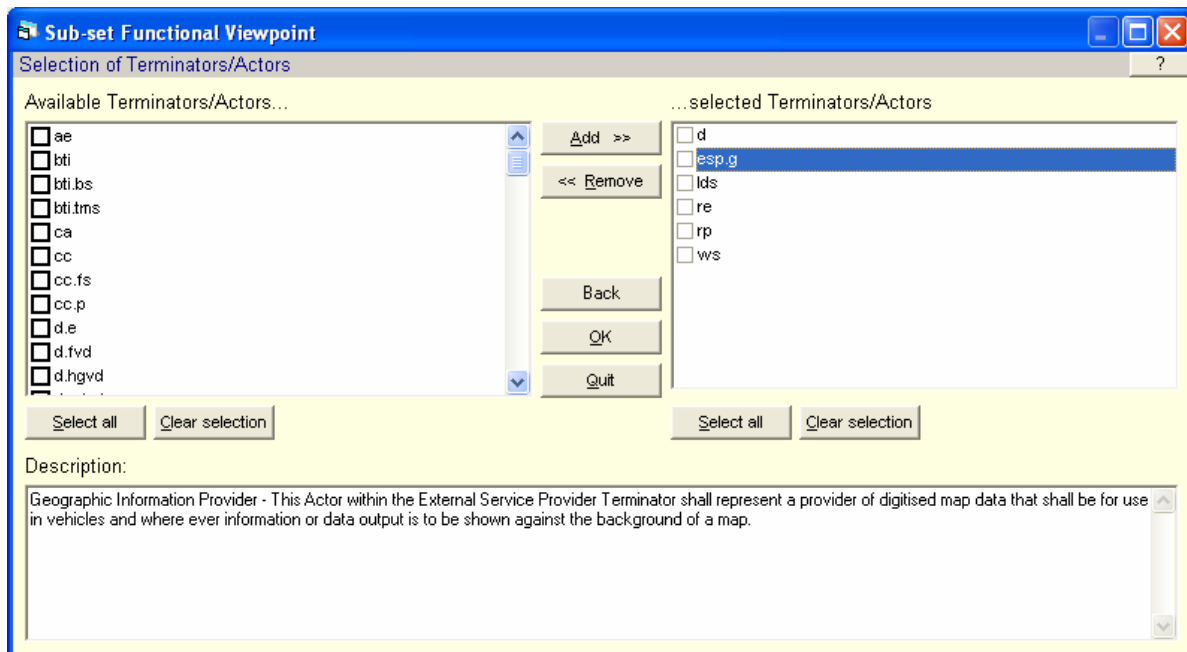
Objective

To select the Terminators and Actors required for the ITS Architecture sub-set. See also Section 2.3.

Explanation of the Screen

First Pass – all the Terminators and Actors which are associated with the Data Flows that have been selected in the previous screens are displayed on the left hand side of the screen.

Remaining Passes – all un-selected Terminators and Actors are displayed on the left hand side of the screen.

Those Terminators and Actors that are selected are then moved to the right hand side. When a Terminator or Actor is highlighted, its description is shown in the text box at the bottom of the screen.
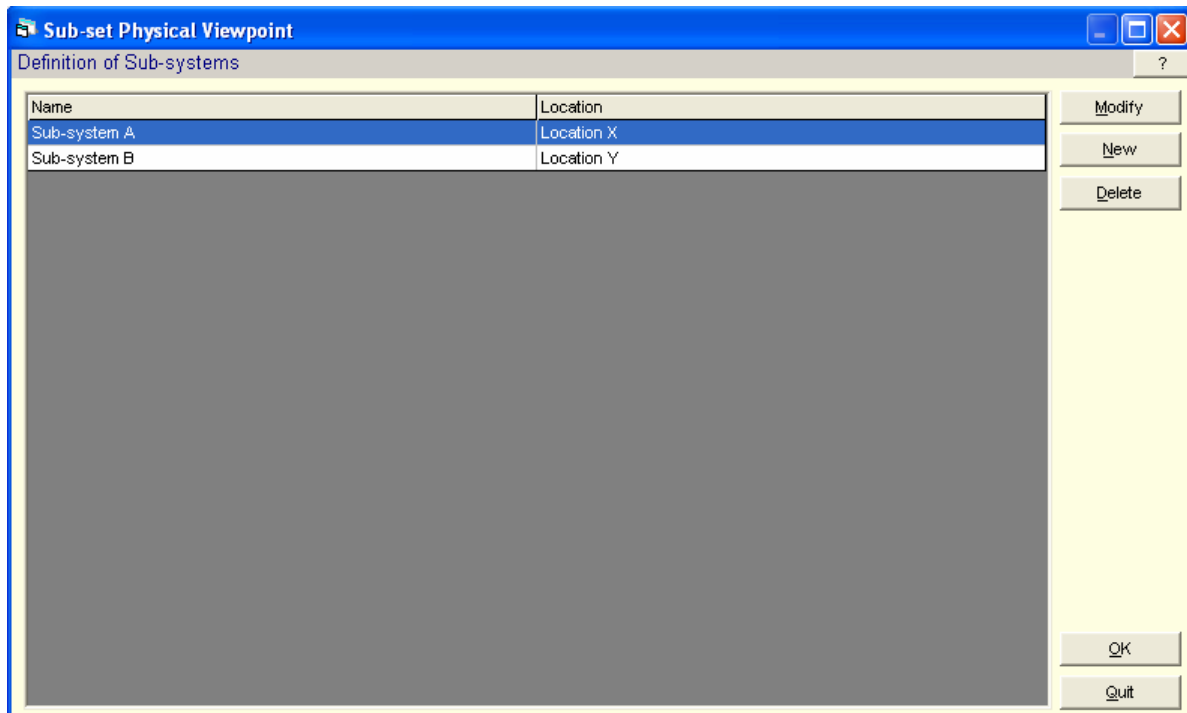
Hint(s)

- You need to understand how the various Terminators, Actors and Functions relate to each other, and you use the Browsing Tool (from www.frame-online.net) to do this.

3.7 Current Consistency Errors and Warnings
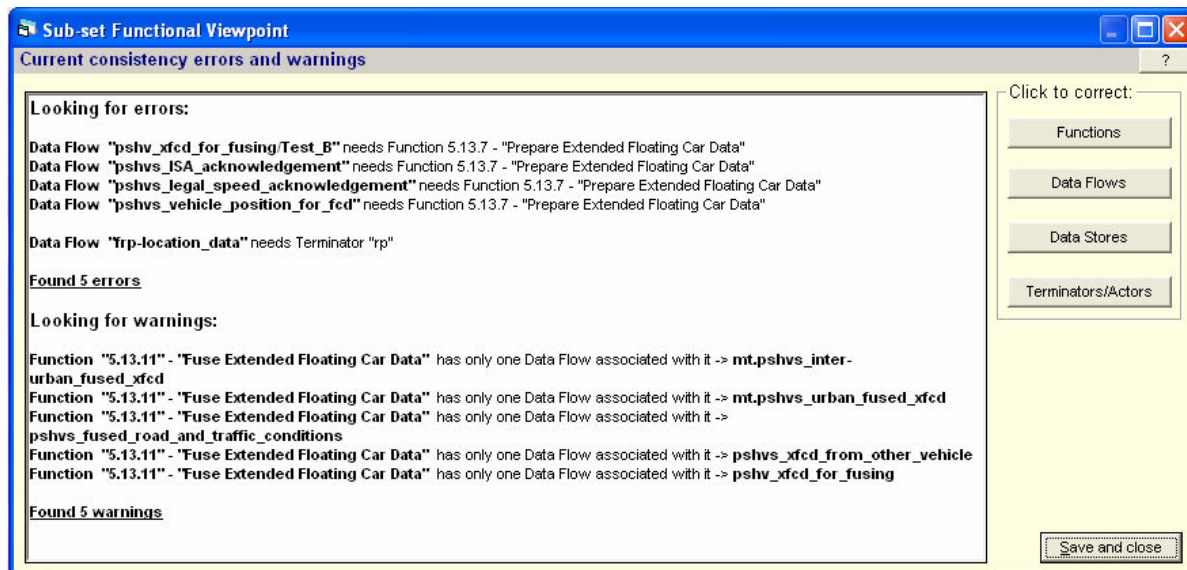
Objective

To show the logical errors that the Selection Tool has found with the current selected ITS Architecture sub-set.

Explanation of the Screen

Errors – these occur when:

- A data flow has an element at only one end;

- A Function or Data Store has no associated Data Flows connected

Warnings – these occur when a Function or Data Store has only one Data Flow connected.

The remaining information contains suggestions as to how to correct the specific error or warning. The buttons on the right enable you to go back to a specific stage in the selection process, whilst this window remains visible.

Hint(s)

- You need to understand how the various Terminators, Actors and Functions relate to each other, and you use the Browsing Tool (from www.frame-online.net) to do this.

- It is not necessary to apply every suggestion. Indeed, if you do, you could end up with a much larger ITS Architecture sub-set than you need, or one that is wrong!

- If you have a lot of errors, only correct a few at a time. You can also print out reports of all the errors (see Section 2.2).

- The warnings are given because it is normal for each Function and Data Store to have at least one input and one output. However, if you are not fully developing a section of the ITS Architecture sub-set, you may wish to keep things this way.

- A report of "none found" does not mean that your ITS Architecture sub-set is 100% correct, only that it looks correct! You may have chosen the wrong elements altogether.

4   Creating a Physical Viewpoint Sub-set

4.1   Definition of Sub-Systems

Objective

To define the Sub-systems that will form the Physical Viewpoint.

Explanation of the Screen

The name and location of each Sub-system in the Physical Viewpoint is provided by the user.

Hint(s)

- The names should normally be meaningful, as this will aid later comprehension.

- The location should be either a specific building etc. otherwise a generic location can be given, e.g. Central, Roadside, Kiosk, Vehicle, Freight Device, Personal Device

4.2 Allocation of Functions/Data Stores to Sub-systems

Objective

To allocate each Function and Data Store in the Functional Viewpoint to one of the Sub-systems defined in the previous screen.

Explanation of the Screen

The Function and Data Stores in the Functional Viewpoint are displayed as "not allocated" and the user "Modifies" the Sub-system in which they will be located.

When a Function or Data Store identifier is selected its description is shown in the text box at the bottom of the screen.

Hint(s)

- It is often easier to decide where all the Functions and Data Stores are to be located before starting to create the Physical Viewpoint with the Selection Tool using a table:

Sub-systems		Modules	Functions / Data Stores	
Name	**Location**	**Name**	**No**	**Name**
ABC	Centre	M1	Fn.n	XXX
		M2	Fp.q	YYY
DEF	Roadside		Fv.w	ZZZ

- On rare occasions it can found necessary to have the same function in two different locations. But first is necessary to "Add Duplicates" (see Section 5).

4.3 Definition of Modules
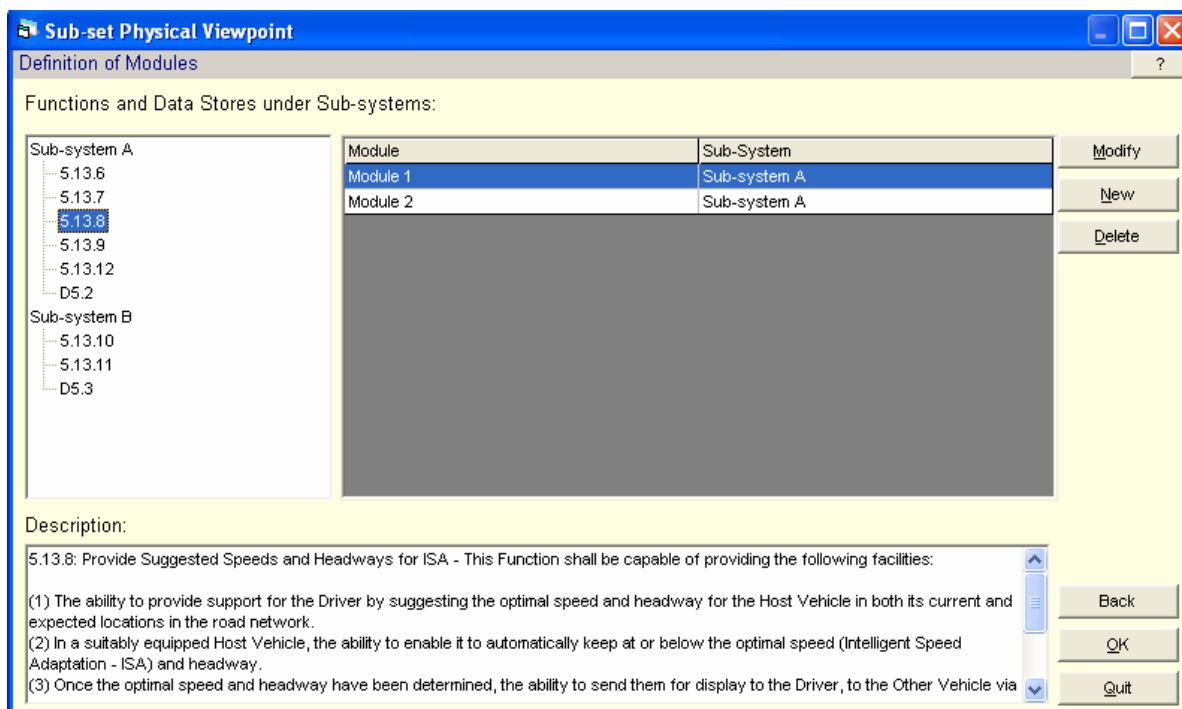
Objective

To define the Modules which comprise one or more Sub-systems

Explanation of the Screen

Each Module is given a name and allocated to a Sub-system.

When a Function or Data Store identifier is selected its description is shown in the text box at the bottom of the screen.

Hint(s)

- The names should normally be meaningful, as this will aid later comprehension.

- It is not necessary to split every Sub-system into two or modules. Indeed this screen should be ignored if no modules are to be defined.

4.4　Allocation of Functions/Data Stores to Modules

Objective

To allocate each Function and Data Store in one or more Sub-systems to the Modules defined in the previous screen.

Explanation of the Screen

The Functions and Data Stores in the Sub-Systems that have been split into Modules are displayed and the user "Modifies" the Module in which they will be located.

When a Function or Data Store identifier is selected its description is shown in the text box at the bottom of the screen.

Hint(s)

- It is often easier to decide where all the Functions and Data Stores are to be located before starting to create the Physical Viewpoint with the Selection Tool (see Section 4.2).

4.5   Resulting Physical Data Flows

Objective

To provide information about the resulting Physical Data Flows, which can then form the basis for a Communications Viewpoint.

Explanation of the Screen

The screen shows a list of the Physical Data Flows, and where they go from and to. Since they are recalculated each time the screen is shown, the identifier "Pnnnnn" also changes each time, starting at the next 1000.

When a Physical Data Flow is selected, the Functional Data Flows that comprise it are shown in the text box at the bottom of the screen.

Hint(s)

- The information on the screen is very basic. Much more information can be obtained from the Report on Physical Data Flows (see Section 2.2), which provides a list of the Functional Data Flows contained with each Physical Data Flow as follows:

Physical Viewpoint			From the Functional Viewpoint			
Physical Data Flow	Parent Sub-system / Module	Target Sub-system / Module	Functional Data Flow	Source Function	Destination Function	Description

5 Adding Duplicate Elements

Objective

To add duplicate Functions and Data Stores, together with their associated Data Flows, to the Functional Viewpoint.

Explanation of the Screen

Initially the names of the all the current Functions and Data Stores in the Functional Viewpoint Sub-set are shown.

1. Select a Function or Data Store to duplicate, give it a "New Suffix" to distinguish it from the original, and "Add" it to the Functional Viewpoint.

2. Now select a Data Flow that is to be associated with the duplicated element, and "Add" it to the Functional Viewpoint. It will be given the same suffix as that of the duplicate element.

3. Continue to "Add" Data Flows until you have all those that you require for this duplicated element.

4. Return to stage 1 if you want to duplicate another Function or Data Store.

Hint(s)

- The maximum number of characters available for a suffix is dependant on the current length of the name of that element (the total maximum length is 60 characters).

- *IMPORTANT* – You *must* complete the addition of the Data Flows *before* duplicating another Function or Data Store.

6 Creating an Organisation Viewpoint Sub-set

6.1 Definition of Organisations

Objective

To define the Organisations that will be in the Organisational Viewpoint.

Explanation of the Screen

The name of each Organisation in the Physical Viewpoint is provided by the user, together with an optional comment.

Hint(s)

- The names should normally be meaningful, as this will aid later comprehension.

6.2 Allocation of Functions/Data Stores to Organisations

Objective

To allocate each Function and Data Store in the Functional Viewpoint to one of the Organisations defined in the previous screen.

Explanation of the Screen

The Function and Data Stores in the Functional Viewpoint are displayed as "not allocated" and the user "Modifies" the Organisation to which they will be assigned.

When a Function or Data Store identifier is selected its description is shown in the text box at the bottom of the screen.

Hint(s)

- It is often easier to decide to whom each Function and Data Store is to be allocated before starting to create the Organisational Viewpoint with the Selection Tool using a table like this.

Organisation	Functions / Data Stores	
Name	No	Name
ABC	Fn.n	XXX
DEF	Fv.w	ZZZ

- On rare occasions it can found necessary to have the same function under two different organisations. But first is necessary to "Add Duplicates" (see Section 5).

6.3   Resulting Organisational Data Flows

Objective

To provide information about the resulting Organisational Data Flows.

Explanation of the Screen

The screen shows a list of the Organisational Data Flows, and where they go from and to. Since they are recalculated each time the screen is shown, the identifier "Onnnnn" also changes each time, starting at the next 1000.

When an Organisational Data Flow is selected, the Functional Data Flows that comprise it are shown in the text box at the bottom of the screen.

Hint(s)

- The information on the screen is very basic. Much more information can be obtained from the Report on Organisational Data Flows (see Section 2.2), which provides a list of the Functional Data Flows contained with each Organisational Data Flow as follows:

Organisational Viewpoint			From the Functional Viewpoint			
Organisational Data Flow	Parent Organi-sation	Target Organi-sation	Functional Data Flow	Source Function	Destination Function	Description