Assistance for the design of interoperable transport in France: ACTIF

ACTIF presentation and user guide documents

Presentation of the model

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Centre for the study of Urban Planning, transport and public facilities

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1. Introduction

1.1 About this presentation document:

Assistance for the design of interoperable transport in France (ACTIF) is a toolkit box put in place by MEEDDAT, designed to help transport system designers and project managers to make them interoperable, i.e. capable of exchanging information, collaborating and sharing technical solutions. The system is based on:

– a method for implementing interoperable transport systems, described in a methodological guide;

– a model which provides a **representation of transport sectors(professions?) and the interfaces between them**;

– a set of tools for accessing and using the knowledge described in the model.

This document is part of a set of similar documents, which are designed to present the entire model in an instructive way and which set out the general principles under which the model can be adopted by ACTIF users. It is the **framework document**, which sets out the entire model, the logic behind its design and the modelling rules used.

Other documents provide a more detailed explanation of the functional areas represented within the model. They have a greater focus on particular sectors and services and go into greater detail about the content of the model.

These documents are available for public viewing and downloading on the following website: http://www.its-actif.org.

1.2 Document contents

This document is arranged as follows:

- general modelling principles;
- the functional scope described and possible extensions of this scope;
- a description of the model (elements represented and links between these different elements);
- various representations of the model and how to use them.

2. General principles behind the model

A model, by definition, is a simplified representation of a more complex reality. This representation is limited to those elements necessary and sufficient required to understand how the system works, to forecast behaviour in a given context and to plan solutions within certain limits and under certain conditions. A model must therefore be easy to understand and easy to use.

In order to achieve this, it is important to:

- define the subject of the model - what it is supposed to represent;
- set out its scope - what it is supposed to be used for;
- describe the modelling rules used - defining the elements, how these elements are described and the links between them;
- describe how to use the model - including the tools which will allow to use it.

2.1 Purpose of the ACTIF model

The ACTIF model provides a **representation of transport professions**, viewed from the perspective of **information systems**. The activities that it describes are based around functions designed to **collect, store, process and disseminate data of increasing complexity**.

This choice is based on four major considerations:

- The development of information and communication technologies has been a key driver in the emergence of new services, new sectors and associated activities;
- There is already a wide range of activities that can be classed as basic data processing activities, producing compiled data that can be used to launch other processes;
- By creating a chain between the compiled data dissemination function of one activity and the data reception function of a second activity, it is possible to describe a series of logical, functional chains that go beyond existing structures and organisations;
- This logical representation can be separated from specific technologies and organisations, to create a sufficiently stable, generic model.

The purpose of this model is therefore:

- To present (or show) the potential interfaces between structures and organisations in similar or different sectors* that may be required to collaborate, coordinate activity, interoperate, etc.;
- To identify the areas in which standards exist or need to be defined;
- To take advantage of sector-based expertise and to act as a reference and knowledge database;
- To provide a model of how transport systems operate and are organised in practical examples.

This last point raises the possibility of using a selection tool for the elements described in the model. This would involve representing how real systems, organisations and structures operate using an abstract model.

2.2 Scope of use

2.2.1 The functional areas covered

In order to make the representation easier to understand and use, the transport sectors covered by ACTIF are grouped into **functional areas**, each of which corresponds to structures, organisations or services found in the real world.

The ACTIF model contains nine functional areas. They are segmented and numbered in accordance with the equivalent European framework (FRAME):

- FA1: provide electronic payment facilities;
- FA2: manage safety and emergency services;
- FA3: manage transport infrastructures and their traffic;
- FA4: manage public transport operations;
- FA5: provide advanced driver assistance systems;
- FA6: manage and inform on multimodal transportation;
- FA7: enforce regulations;
- FA8: manage freight and fleet operations;
- FA9: manage shared data.

Each of these functional areas is described in a specific presentation document. As far as possible, each functional area is independent from specific modes of transport. They may involve the use of road, rail, river, sea or air transport infrastructures. The modes of transport involved may include buses, metros, trams, boats or cars. The terminology used may display a bias towards road transport, since this was the dominant element in previous versions.

2.2.2 The functional sub-areas or sectors

Each functional area comprises its own functional sub-areas. These sub-areas are similar to the concept of “sectors* professions”, in the sense that the type of data they process is largely constant. In general, as a result of the logic that has appeared over the course of successive developments of the model, the following functional sub-areas have been defined for each functional area:

- describe the service (theoretical offer, pricing, travel conditions, rules);
- elaborate, assess and update operating strategies;
- monitor and analyse field information;
- regulate or manage in real-time (strategy implementation and monitoring);
- manage shared data within a particular sector.

This logic has not yet been fully achieved. This is due to the demands of each sector (and experts) and the overall complexity of the system. This may also lead to deficiencies in certain areas, which should be resolved in future developments of the model.

The scope of use of ACTIF is therefore limited solely to these functional areas. It may be possible to represent sectors and organisations that fall outside this framework through the use of analogies.

2.3 Modelling rules - initial approach

The decision to represent transport sectors(? Or professions) and their associated logics from the perspective (? Point of view) of information systems means that there are certain basic principles that need to be followed to make the model relevant and comprehensible, both in terms of how different sectors(?) are represented and in terms of how the model is used to describe real transport systems and ITS's.

The basic rules that were followed when creating the logical representations of all sectors within the model are as follows:

- it should be easy to read;
- the functional chains should be easy to understand;
- there should be consistency across the entire model.

2.3.1 The functions - datastores

As a result of the links with information systems in the transport field, also known as ITS's (Intelligent Transport Systems), it has been possible to identify those elements that are consistently stable across all sectors. The following functions have been identified:

- information collection,
- information storage,
- information processing,
- preparation of information for dissemination.

2.3.2 Data flows or messages

These functions all generate or receive data flows (messages).

The collection functions gather basic information either from the dissemination functions of other sectors (within the ACTIF model) or from the outside world (via sensors in the location concerned, from third parties, or from other systems not included in the ACTIF model).

The dissemination functions send generated messages either to the collection functions of other sectors (within the ACTIF model) or to the outside world (via equipment in the location concerned, to third parties, or to other systems not described in the ACTIF model).

The basic data comes either from other sectors represented within ACTIF, or from "external third parties". named "terminators" In the same way, the information generated by the processing function is disseminated to other sectors or to "external third parties"terminators. The term "terminator" refers to entities, individuals or systems for which the internal logic is not represented within ACTIF: field equipment, partner structures and organisations, drivers and users, etc.

For example, an **infrastructure manager** (whose role is described within ACTIF) receives "event alerts" from field equipment (cameras, loops, etc.), which he/she then processes before disseminating his/her "analysis" to the people in charge of implementing a field event management strategy. If traffic regulation measures are needed, he/she communicates the relevant information to the infrastructure's users via variable message signs (VMS's) or other types of media (radios). The cameras, counters, VMS's, radios and users are all classed as "terminators".

The "disseminated event" information may also be sent to the relevant **public transport operator**, who will take the necessary "regulation measures" (possible service modifications). These "regulation measures" will be communicated to the vehicle (driver) and/or to passengers and other users.

2.3.3 Functional chains

The various transport sectors are modelled within ACTIF using very simple representation principles, making it easy to follow the different information processing and development **functional chains** and to identify the interfaces with the outside world and other sectors on the representation diagram (also known as the generic architecture or "pattern") presented in figure 1.

The functional chains described in the model are logical chains of information collection, storage, processing and dissemination functions, which send information to other collection functions, storage functions, etc. This may involve closed processes, i.e. which originate from and terminate with an external third party. It may also involve internally cyclical processes, either as part of cooperation between partners, or where there are plans to assess the processes and strategies implemented.

These logical chains must not be viewed solely from the point of view of the technical and ICT systems required to achieve them. **They must be seen rather as functions that are part of a wider transport service arrangement, which includes automation or human intervention (ICT technologies are then used to assist decision-making).**

The purpose of the ACTIF model is to provide a representation of the operating logic within different transport activity sectors and any collaborations and information exchanges that may exist between these sectors. The idea is to present these sectors in the form of **stable, logical functional chains that are independent from specific technologies and organisations.**

3. Description of the ACTIF model

3.1 Generic architecture of the model - the “pattern” concept

In order to ensure that the model can be used effectively in the future (particularly with OSCAR the simplified architecture design tool), it is important to understand the structure used to represent the different transport sectors. As indicated in paragraph 2.3, it was deemed necessary to break the model down into functional areas based on homogeneous sectors.

These different sectors process specific types of information for pre-defined purposes. For example, emergencies are managed by two specific sectors:

- call processing (in call processing centres): from taking calls to disseminating processed information to intervention services;
- intervention management.

The link between these two sectors is based on the communication of information concerning a particular emergency from the first to the second.

Sector (functional sub-area) diagrams are created using a generic logic as shown below:

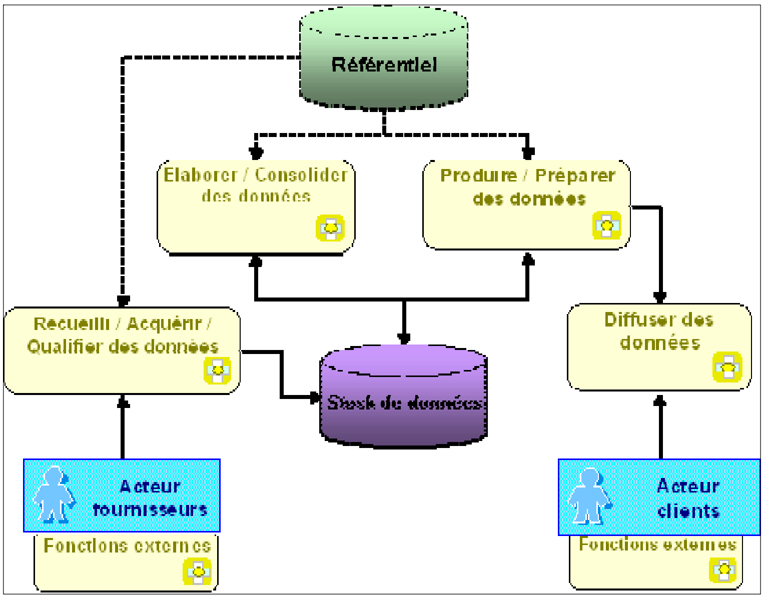


Figure 1: Generic architecture

The principle is as follows:

- Data from external third parties and/or functions are fed into one or more “Collect / acquire data” functions. Only these functions are authorised to receive data from the outside world.
- The “Collect” functions perform a basic test (origin, format, etc.) on the collected data, them forward them to a Datastore.

- The Datastore stores all permanent data relating to a particular sector (e.g. Event data). The data stored may be raw, aggregated, consolidated, summarised, etc. It is important to note that the existence of this element does not necessarily mean that an IT database is used. The Datastore automatically includes a range of functions including access control, access management, query management, etc.
- A “Compile” or “Consolidate” function is then used to search for data in the Datastore, consolidate these data (consistency test, homogenisation of data from different sources and in different formats, etc.) and reinsert these processed data into the datastore.
- A “Produce” or “Prepare” function is then used to search for data in the Datastore, produce data in a format that can be disseminated, reinsert the produced data into the Datastore and send these data to the “Disseminate” function.
- The “Disseminate” function is responsible for sending the data prepared during the previous phase to the intended external third parties and/or functions. The data are disseminated in ether “push” or “pull” mode, as appropriate. This is the only function that is authorised to communicate data to the outside world.
- There are also a number of “reflexive” data flows between the “Disseminate” and “Collect” functions within the same sector. These are designed for the purposes of sharing data between different structures and systems that carry out the same functions.

The “pattern” (or model) shown in figure 1 is used for all data flow diagrams. By using this pattern, it has also been possible to segment/group the functional areas/basic functions according to similar sectors that may exist in the real world.

3.2 The links between functions and functional areas: functional sub-areas or sectors

These basic “Collect / acquire data”, “Compile”, “Produce” and “Disseminate” functions will be integrated into a so-called “aggregated” function. More often than not, this aggregated function represents a functional breakdown of the sectors concerned (see example above).

It is therefore possible to say that an aggregated function must contain information collection, processing (“compile”), preparation and dissemination functions, in the same way that a sector can be described in terms of production output (information) based on specific input (data).

This pattern has been applied universally to create a consistent model (that is simple, easy to read, easy to understand, etc.). For example, below are two relatively similar functions, “Manage emergencies” and “Manage traffic”. These two diagrams clearly demonstrate the “pattern” concept and the symmetries between the two functions. Similar strategy selection and implementation sub-functions are outlined using the same colour.

These functional sub-areas are essential to the remainder of the model. They act as:

- the basic entry point into the model, as proposed on the website: the data flow diagrams are a logical representation of how each sector operates, from the input of essential data and the source of this data, to the production and dissemination of outgoing information and its recipients.
- the basis upon which real functional systems are defined in OSCAR - this concept is used to select activities.

In turn, the functions are linked to each functional area through their association with functional sub-areas and, where applicable, aggregated functions. This link is represented in the functional tree diagrams (figure 3).

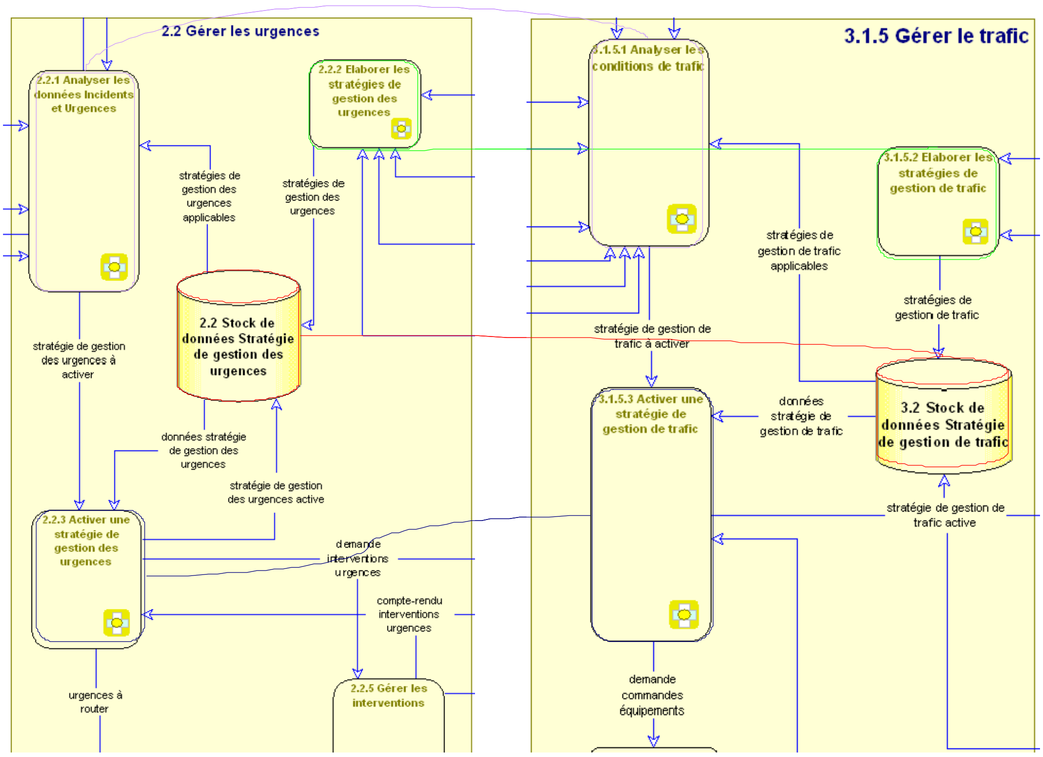
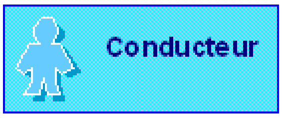


Figure 2: comparison of two functions (pattern concept)

3.3 The components of the model

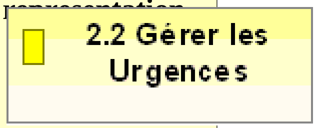
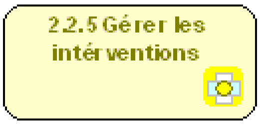
3.3.1 Terminators (sur tout le document)

Definition	External Third Parties are interaction points between transport systems and their environment. They both transmit and receive information.
Visual representation	
Naming convention	A short, meaningful name *Examples Regulatory enforcement authority* *Field camera / AID equipment* *Operator*
Characteristics	There are four types of external third party: • physical entities: Environment, Road surface, etc. • human entities: Operator, Driver, Traveller, etc. • systems: emergency systems, atmospheric condition system, etc. • organisations: transport authorities, financial establishments, etc.
Specific rules	An external third party is not a real entity, but a representation of an entity's role in relation to the system: e.g. the same person may be considered a *traveller, driver, customer, caller*, etc. depending on the role that they are playing in relation to the system. Our interest in these third parties is restricted to their role as a trigger for a particular sector process, as a provider of information that the system collects and processes, or as a recipient of the information that the system produces. We are not interested in the internal functions of third parties for the purposes of the model (black box concept). their functions are not described.
Management rules	• ??Third parties are only represented on a single level (no parent or sub-directories) • An external third party transmits and receives data flows only • An external third party only transmits data flows to, or receives them from, basic functions • An external third party never transmits data to, or receives them from, other external third parties

3.3.2 Functional areas (FA)

Definition	The functional areas represent a homogeneous, commonly-recognised breakdown of the main transport-related activities. In terms of the ACTIF model, they are the first criteria by which the functions are segmented. In its current state, the ACTIF model is designed to create / analyse system architectures in 9 functional areas: • FA1. Provide electronic payment facilities • FA2. Manage emergency and safety services • FA3. Manage transport infrastructures and their traffic • FA4. Manage public transport operations • FA5. Provide advanced driver assistance systems • FA6. Manage and inform on multimodal transportation • FA7. Enforce Regulations • FA8. Manage Freight and Fleet Operations • FA9. Manage Shared Data
Visual representation	
Naming convention	Name consisting of a number indicating the area, followed by a short phrase describing the area and starting with a verb.
Management rules	The functional areas are linked solely to aggregated functions, which represent sections of the activity described: they group together these aggregated functions. They do not transmit any data flows (or messages) directly. They appear in the model via context views. The links between external third parties and other functional areas are represented as channels, covering all the information exchanges described in greater detail.

3.3.3 Functions

Definition	A function is an information processing operation. Functions are defined from the hierarchical breakdown of each functional area.
Characteristics	In order to manage the different levels of representation, functions are grouped into hierarchical tree diagrams (one per functional area): • Functions that group together other functions, known as “aggregated functions”; • Functions at the bottom of the tree diagram (no sub-directory), known as “basic functions”.
Naming convention	Name consisting of a number with several digits, separated by full stops, and a short sentence describing the activity and starting with a verb (infinitiv form). The first number corresponds to the number of the functional area to which it belongs, the second is the number of the function within the functional area, and any subsequent numbers represent its position in the functional hierarchy.
Visual representation	Aggregated functions and basic functions are represented differently:   <u>Aggregated function</u> <u>Basic function</u>
Management rules	**Basic functions** • A basic function only belongs to a single functional sub-area, or a first level aggregated function. • A basic function transmits and receives messages or data flows to or from other datastores, basic functions, or external terminators. • Basic functions are divided into three types: collection, processing and information dissemination functions. The incoming information processing* process is integrated into this function. (processing procedure? ??) • A basic function does not have any sub-directories within the ACTIF model. **Aggregated functions** There are two levels of aggregated functions: • **functional sub-areas**, which contain basic functions and datastores. • second-level aggregated functions, which contain several functional sub-areas (in functional area 8 only).
Management rules	• aggregated functions only belong to a single second-level aggregated function or a single functional area. • aggregated functions do not transmit any data flows (or

	messages) directly. • aggregated functions appear in the model via **context diagrams**. • the links between two aggregated functions are represented as channels, which cover all logic flows between the basic functions (or datastores) belonging to each one. • similarly, the link between an aggregated function and an external third party is represented as a channel which contains all logic flows described in greater detail.
Specific rules	**In representations of the model created using the MEGA tool**, the hierarchical links between basic functions and the aggregated functions to which they belong are presented in “flowchart” type diagrams, known as **functional tree diagrams**. **Basic functions** appear in **data flow diagrams** and in **themed views**, since they describe an information processing process. **Aggregated functions** appear in **context diagrams**, since these show all possible interfaces between aggregated functions and third parties. The interfaces are represented as channels which contain all data flows described in greater detail. **When using the model as proposed by the OSCAR tool,** The sub-systems are described in terms of the basic functions that they fulfil and the datastores that they contain. An aggregated function is therefore selected implicitly on the basis of all the functions and datastores that it contains. Partners are described either in terms of the external third parties or aggregated functions that correspond to their role.

3.3.4 Datastores

Definition	These represent elements designed to store data processed by an information system and make it available to other functions. They contain either permanent data for archiving and viewing, or temporary data used for “real-time” information processing, e.g. by “intervention strategies” which rely on(?) an analysis of a given situation. They also act as a “log book” within the model, as they are supplied, in real time, with information from the processing and information dissemination functions.
Visual representation	
Naming conventions	Name comprising a number with 2 digits, separated by a full stop, and a name ending with “…Datastore”: • The first digit indicates the functional area to which it belongs; • The second number relates to the datastore’s position within the functional area. *Examples: 1.4 Customer Contract Datastore* *7.1 Rules and Related Offences Datastore*
Characteristics	The datastore concept is used to represent data used by several functions within the model: the model therefore involves access to a datastore rather than circulation of information from one function to another.
Management rules	Datastores are linked to one functional area only. In the OSCAR tool, selection is carried out via the functional sub-area.* Datastores only transmit or receive logic flows (or data flows) to or from basic functions. Therefore, they do not transmit data flows directly to external third parties.

3.3.5 Logical Flows

Definition	A logic flow is a data exchange between elements of the model that cannot be broken down: basic functions, external third parties and datastores.
Visual representation	
Naming convention	The flow name consists of a short phrase, with words separated by spaces. Some flows are preceded by the prefix “REF_”, signifying that these are reflexive flows. Flows of this type are sent from a particular dissemination function and return to the collection functions of the same functional sub-area. These are used to exchange information between structures carrying out the same role.
Characteristics	The model contains a number of “reflexive” flows: these are sent from dissemination functions to information collection functions within the same functional sub-area. These are used to exchange information between structures carrying out the same role. In the OSCAR application, these flows are shown when modelling sub-systems that fulfil very similar functions. Similarly, there are “exchange flows”, which separate flows belonging to a particular sub-area and those that come from other sub-areas. The selection of these flows will be shown in the OSCAR tool.
Management rules	Each flow is unique: as a result, it can only have one source, but several recipients. Flows received or transmitted by third parties can only come from or be intended for basic functions. Logic flows received or transmitted by datastores can only come from or be intended for basic functions. Aggregated functions and functional areas do not transmit or receive logic flows. Logic flows are only represented on a single level (no parent or sub-directories) They can be integrated into channels for the purposes of representing the interfaces that exist between an aggregated function and other aggregated functions or external third parties. A channel between two aggregated functions is used to describe the logic flows that may exist between basic functions or datastores belonging to each one. Each logic flow is only listed once, even when a flow is transmitted to several basic functions within an aggregated function.

3.3.6 Standards

Definition	These represent the standards, method and usual rules,

	recommendations, de facto standards and good practices that can be applied to each element within the model: logic flows, external terminators, datastores, basic functions, aggregated functions and functional areas.
Visual representation	
Naming convention	Meaningful label (recommendation) or name (standard) *Examples: traveller information via DSRC* *EDIFACT*
Management rules	Standards are linked to all subjects to which they can be applied.

3.4 Different visual representations

The ACTIF model can be represented in three different ways:

- Functional tree diagrams: these represent the hierarchical links between basic functions and the aggregated functions to which they belong (see figure 3);
- Logical views: data flow diagrams or context diagrams.
- Thematic views.

3.4.1 Functional tree diagrams

The ACTIF model is represented using a hierarchical functional breakdown. The top level of the hierarchy contains the functional areas. These are divided into aggregated functions or functional sub-areas, which correspond to specific sectors. These are then divided into basic functions, which are described in greater detail.

For functional area 8 (Freight and Commercial Fleet Operation), which is a particularly vast area, an intermediate division is required, involving second-level aggregated functions. The functional tree diagrams show these links.

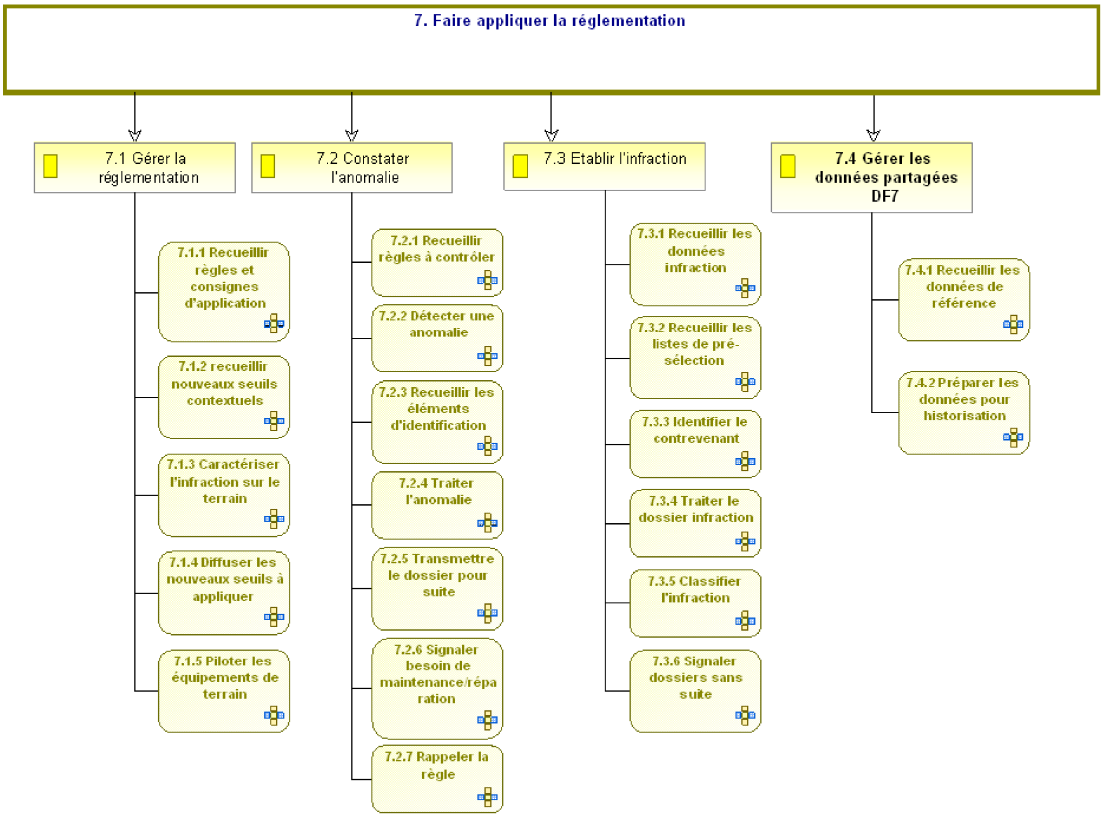


Figure 3: Functional tree diagram of a functional area

By definition, these functional tree diagrams always contain three levels of division. As shown in figure 3, they contain:

- the functional areas,
- all aggregated functions within an area,
- all basic functions within an area.

For functional area 8, there are two possibilities: present the functional area and the two levels of aggregated functions (see figure 4), or present the functional tree diagrams for each second-level aggregated function.

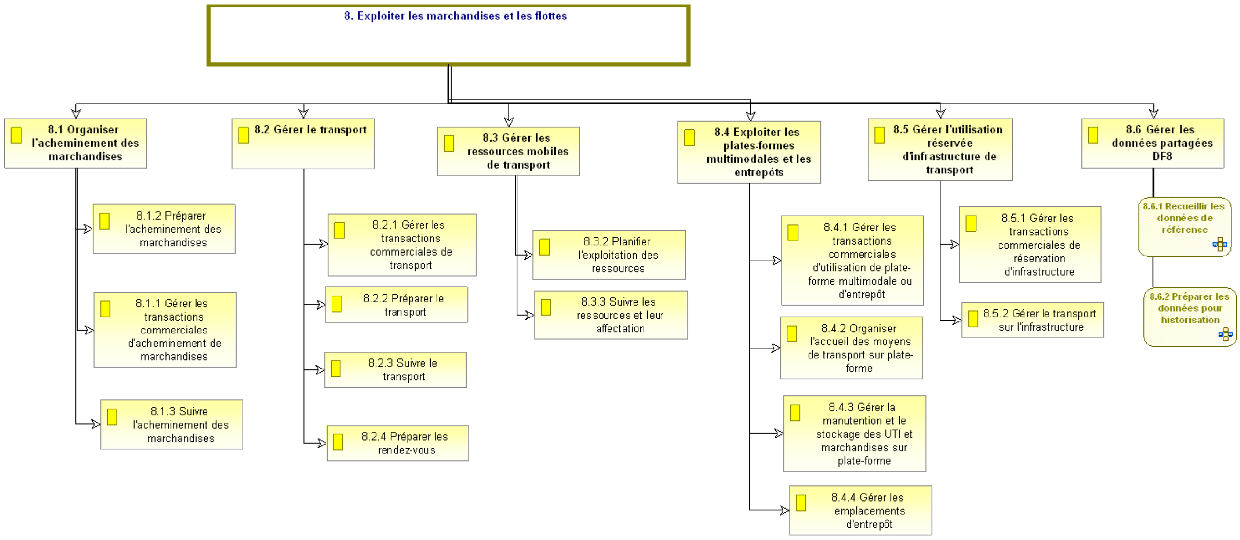


Figure 4: Functional tree diagram for functional area 8

3.4.2 Data Flow Diagrams (DFD's)

A Data Flow Diagram (DFD) is organised into different levels of aggregation, and shows how the roles fulfilled by each functional area are divided between its component functions and how these functions are linked with each other and with External Third Parties through data flows.

When Datastores are used by several functions, these are also represented, along with the data flows that link them to the functions.

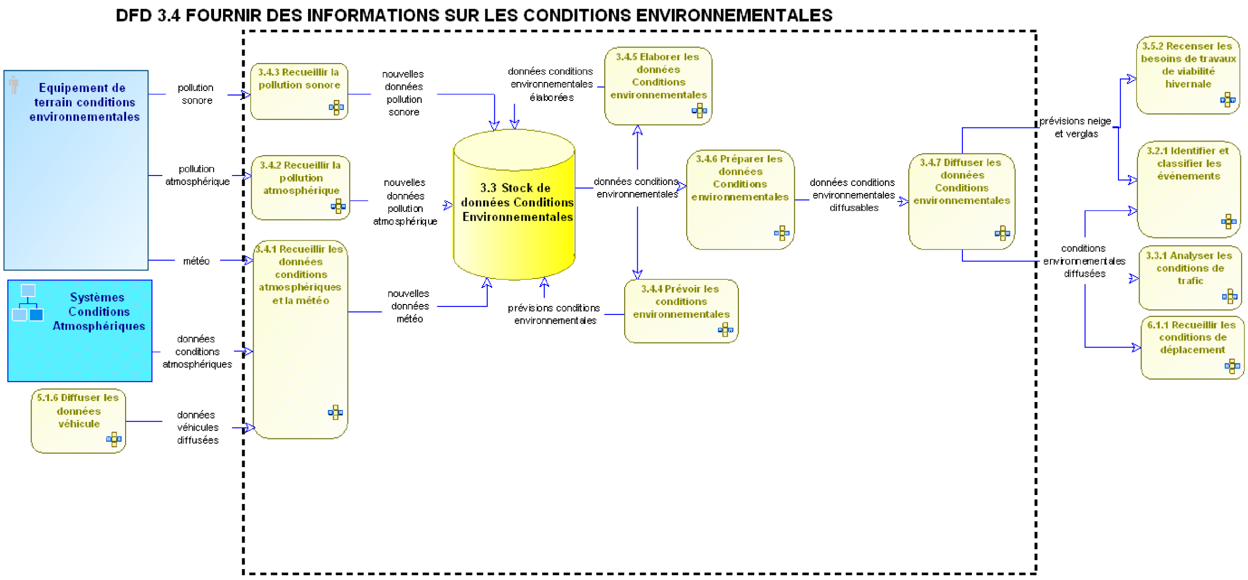


Figure 5: data flow diagram

3.4.3 Context diagrams

These present all relationships between a functional area and its environment (external third parties and other functional areas) on a single diagram. The logic flows are therefore grouped into channels.

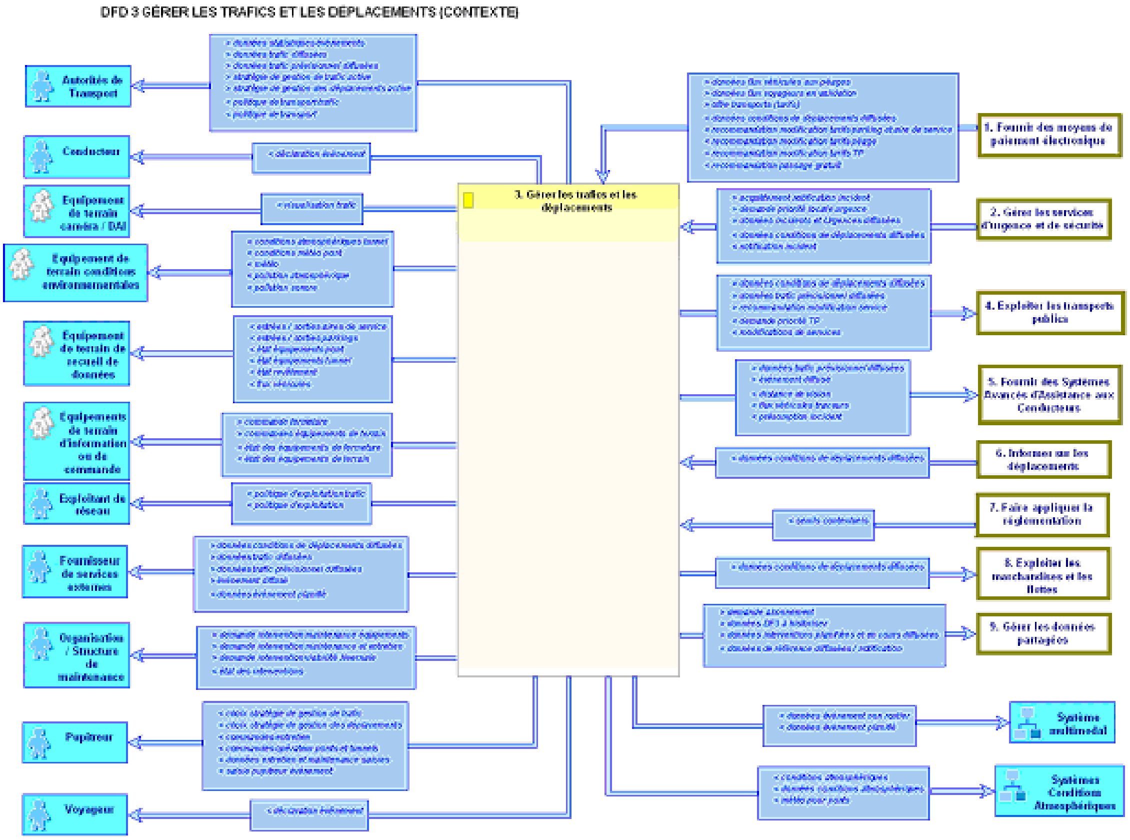


Figure 6: Context diagram

3.4.4 Thematic views

Thematic views illustrate a process, transaction or partial transaction involving elements of the ACTIF model. Thematic views are used to group elements that would not be represented together on a logic view, such as functions and datastores. They also do away with the hierarchical structure of the model that is used in other types of diagram. Thematic views can be used for several purposes:

- To view a process from “end to end”: this shows the information processing logic employed by different functions and levels in specific case
- To show the interfaces between two parts of the model.
- To analyse a section of the model that is of direct interest to a designer
- To check the functional model by applying it to a specific case (implementing a TMP after inputting a significant event)

The thematic views available are based on diagnostic studies. They are created on a regular basis and made available on the ACTIF website.

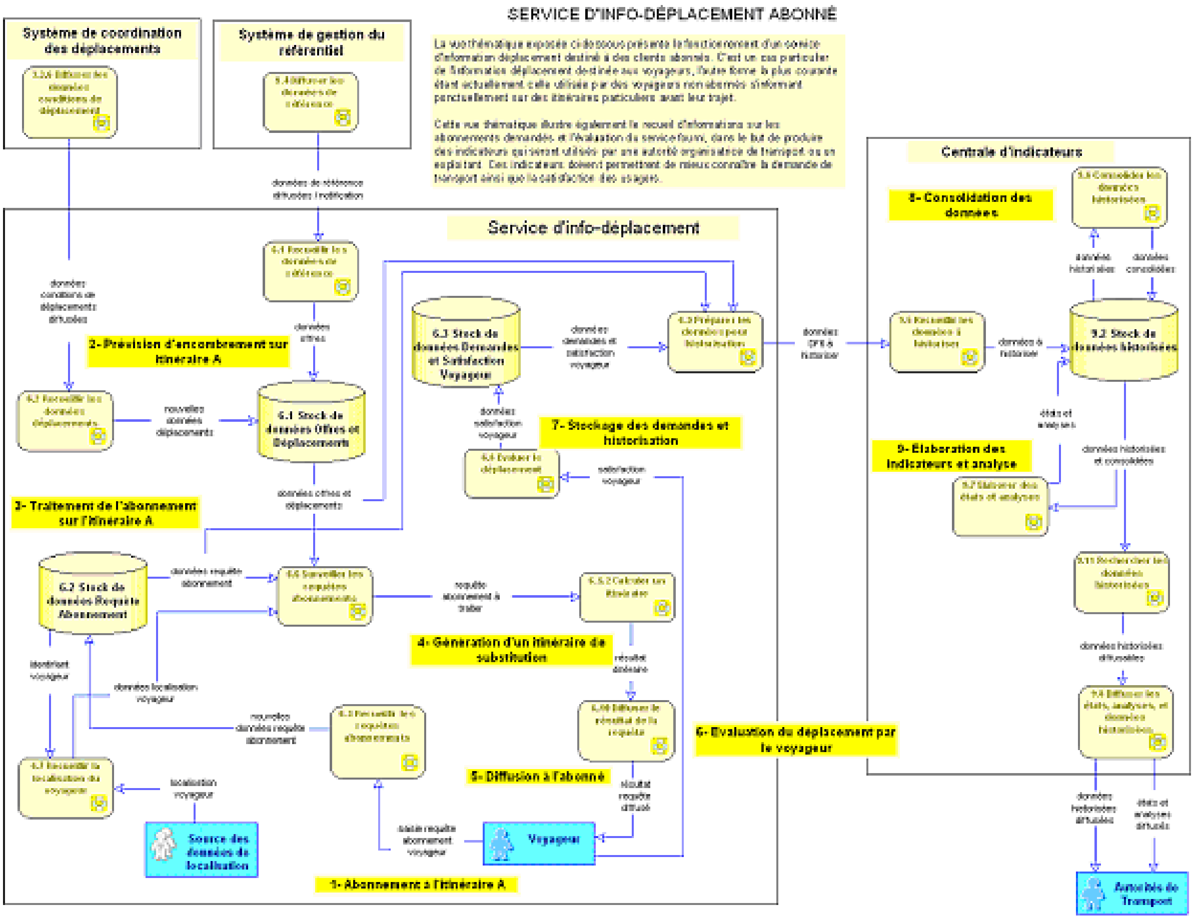


Figure 7: Example of a thematic view: “Travel information subscription service”