A New method of the decision-makers' needs treatment

[*]Outfarouin Ahmad[+], Abdali Abdelmounaîm[+] and Zahid Noureddine[++]

\+ University of Cady Ayyad, Faculty of sciences and technology, Laboratory(LAMAI), MOROCCO
++ University of Cady Ayyad, High School Teachers, MOROCCO

Summary
The decision-makers' needs (DN) analysis process involves a series of phases that guide the success of the discovery of the decision-makers' requirements. A comparative study of different analysis processes of DN, identified a set of problems. Among the problems encountered we cite: misunderstanding and incompleteness of needs, the multitude of user profiles and their goals expressed in different ways. These difficulties can negatively influence the DN process of analysis, and therefore, the collected needs are often vague and not measurable. To remedy these problems, and in order to adequately assist future users in expressing their needs and guide design-analysts in the treatment of the collected needs, we propose in this paper a new method for DN processing. This method is based on a new structure of the DN decomposition, and on new rules of treatment of these needs. In the remainder of this paper, we present in the first part a state of the art of the modeling approaches of the DN, their representation models and their processes of the DN treatment, then in the second part we present our new method of the DN processing, and then we complete this work with the conclusions and a future work part.

Key words:
Decisional information systems, decision-maker needs, decision-maker requirements engineering, treatment process, business intelligence.

1. Introduction

The start-up of a BI project must always go through the phase of discovery of the decision-makers' requirements, this phase is an essential step which answers several questions, these questions' aim is to specify the expectations of the decision-makers vis-a-vis their Decisional Information System (DIS).

The Requirements' Engineering (RE) is a science that focuses on the study of the requirements' discovery. Several approaches have been proposed to analyze the needs of the decision-makers; these approaches follow a guided process in terms of techniques and models, involving the decision-makers of the organization and the business experts [1].

This process involves several steps, the main ones being:

- Collecting DNs, which collects all the aims of the different actors in different domains, either in the models' form or in the natural language form.
- Treatment of the needs which is an essential stage and whose objectives are to classify the goals into three categories: strategic, tactical and informational, also to associate and / or break down each strategic goal into tactical goals, and to associate And / or decompose each tactical goal in turn into informational goals. At the end of this step, there is a set of valid informational goals that can be used in the final phase.
- Treatment of the valid informational goals is a stage where we can deduce "the indicators on the facts" and "the indicators on the dimensions" through the formalization models developed in this direction. At the end of this process we obtain as a result a "table of extraction of the decisional data" based on the decision-makers' need.

This process is still having several problems, especially at the second stage, which represents a windmill between the stage of collecting the DN and the formalization of the informational goals. This stage still needs a lot of investigations either on the criteria of the treatment (filtering) of the goals or at the level of the automation and the systematization of the extraction of the indicators on the facts and indicators on the dimensions.

Our work has, as a contribution, to systematize and automate the second stage of this process of the Decisional Needs' Engineering (DNE), namely the treatment of the DN; we propose a new method with new rules of treatment of the different types of DN, which will facilitate the task of the analyst-designer. Based on the new criteria and treatment rules, this work will also limit the syntactic ambiguity of the DN.

In this paper, we propose a new method of the treatment of DN in the DNE process, following the following organization: Section 2 presents a state-of-the-art of the analysis approaches of the DN. In Section 3, we present our new DN processing method. Section 4 contains an example of an implementation. This work will end up with conclusions and future work in section 5.

2. State of the art

For the modeling of DN, the different types of DNE approaches define several stages, and a set of models that

Manuscript received April 5, 2017
Manuscript revised April 20, 2017

allow the collection, the formalization and the treatment of these decisional needs,:

2.1 Types of needs' modeling approaches

In the literature, three approaches are defined for the different DIS engineering methods; it is possible that their subjects concern an approach oriented-data, oriented-requirement or both:

- Data-oriented approaches: also referred to as bottom-up approaches [2] [3] based on the following principle: "All models are modeled, and the Data Warehouse (DW) must be fully developed from the outset". They focus on how to extract the data and transform it into a multidimensional data model, based on the diagrams and classification of the operational sources and the choice of the dimensions and fact parameters.
- The requirement-oriented approaches: or the top-down approaches are based on the philosophy of Kimball [4] whose principle is "We have to build our DW step by step in an agile way, adding each time a part (Data Mart) ". They are based on user and system requirements, and the data sources will be consulted later.
- Mixed approaches combine top-down (decision-makers' need analysis) and bottom-up (data-source analysis) approaches. The construction of the multidimensional schema, in this case, is done with a correspondence, at the same time, between the needs of the decision-makers and the analysis of the data sources [5] [6].

2.2 Needs' representation models

Each step of the DNE approaches corresponds to the establishment of a model; this facilitates the capitalization and archiving of the DNE process. To date, the requirements' representation models are implemented in the form of five possible categories:

- Goal models: Numerous studies are based on the goal models [7, 8]. In this work, the authors use the "i *" (i star) goals model [9, 10], which is a modeling language, defined with dependencies between various types of agents, in order to model situations where one of the agents depends on another to achieve a certain goal, or to carry out a task. Some works [11] propose a decision-makers' needs analysis method that uses a goal model to represent the intentions and strategies put in place to achieve a goal. In other works [6], the authors use a goal model named GQM, to represent the user requirements by using two forms with fields that characterize the decision makers' goals.
- Table models: Some methods for collecting the decision-makers' and the different actors' needs use the table models, specifically in the form of n-dimensional tables containing the concepts of facts, dimensions, measurements, parameters, hierarchies and attributes [12]. In the work of Bargui [13], to collect the needs, we request to the decision-makers to express it in a syntactic model, and afterwards, the analyst-designer treats and extracts the multidimensional concepts and generates the multidimensional schemas.
- Models based on relational schemas: The formalization of DN is made by several types of relational schemas, for example the Entity / Association model [14] [15], the authors use an ideal schema for the formalization, from which we define a candidate schema for the treatment phase, it is on the basis of this schema that our conceptual schema is generated.
- Query models: Queries, in this type of approach, are the basis for modeling the decision-makers' needs, initially, the expressed requirements are captured in natural languages from which the analyst-designer formalizes these needs in the form of queries. In some works [16], authors use these queries to validate candidate schemas defined from sources by verifying that the queries satisfy the "Select" and "From" clauses. In other works [17], the needs expressed in natural languages, when collecting user requirements, are represented with queries, and the next stage of needs' treatment, in which we extract the indicators of the facts (facts table And its measurements) and dimension indicators (dimension tables and their attributes) is done with the needs' matrix. After this step, we define the first star schema extracted using the needs and we confront it with a second star schema which will be made using the data sources.
- Mixed models: In this category, two or more types of models are combined in order to collect, formalize and treat needs. In some works [18], the needs are collected in the form of queries and afterwards formulated into goals and decisions. The authors use a proprietary goal model named GDI (Goal / Decision / Information) to represent the decision-makers' needs. In other works [12], to treat DN, an analytical requirement specification model (queries / tables) is used to extract the fact and dimension tables.

2.3 Decisional needs' processing process

These DNE approaches take the form of a process of needs' analysis, accompanied by models. In the decision-making world, this process usually consists of the following actions: organization diagnosis, and collection, analysis, specification, validation and modeling of the needs.

In the process of some DNE methods, and in order to treat the matrix of relations between goals, the authors define the relation between these goals by a relation of composition by "AND", "OR" and "Refined by"[19] , Or "AND", "OR", "Refined by" and "completed by" [8], this type of relation does not provide an accurate and solid criterion for the treatment of goals, because it is generally based on the intentions of the decision-makers and the analyst-designer, these intentions provoke a very important interval of error, from one analyst-designer to another, we find a difference in the establishment of these relations due to the ambiguity in the distinction between these criteria.
To relieve these problems, a pertinent criterion has been defined which is based on the decomposition of the goal into two main components. Each goal or intent has a result to be achieved (What) and a canal (HOW) to follow in order to arrive to this result, Result (R) contains one or more actions which can be in the form of a verb or A noun, and the canal decomposed, in turn, into one or more means and one or more manners, these two concepts <Result; Canal> still exist for all goals, which will allow us to develop a set of treatment rules that will be the basis of our new method.

3. Our proposition

To introduce our new method, we have developed an activity diagram that illustrates our approach to the DN analysis (figure 1), on which this work has been applied. This approach can be done in five main processes. The first one consists in the collection of the DN to define all the actors' expectations using the natural language. The second allows to classify the decision-makers' needs into three types of goals (strategic, tactical and informational) by specifying the compositional relation between the strategic goals and the tactical goals and between the tactical and the informational goals, also the analyst - designer by attending a business expert can decompose each strategic goal into other tactical goals and each tactical goal into several informational goals. The third process details the collected needs' treatment in the form of goals, and for this step we have developed several rules implemented in our method. The fourth is related to the formalization of the informational goals resulting from previous processes and these goals are valid, processed and ready to be formalized in the section of "indicators on the facts" and in the section of "indicators on the dimensions". Finally, the fifth process is for the production of the decision data table.

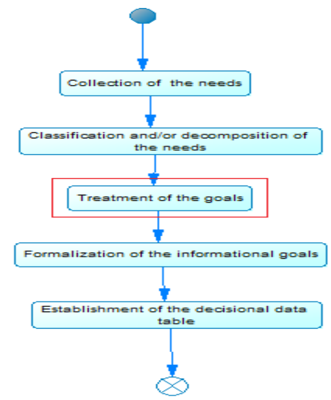

Fig.1 Process of the DN treatment

In this work, we detail the process of the decision goals' treatment. This process consists of three steps, each one of this steps is decomposed into a set of activities.
In the following sections, we will detail the phases of this process and explain the tasks of each phase by determining the associated models.

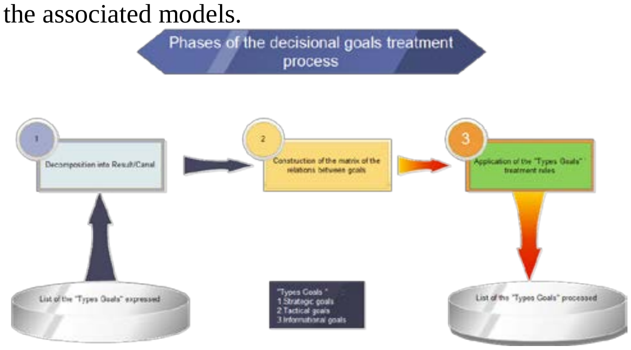

Fig.2 Process phases of the goals' treatment {strategic, tactical and informational}

3.1 Level of abstraction of decisional goals

In the decision-making domain, a strategic goal (level1) does not offer an operational view and must be decomposed into tactical goals, this level (level2) does not yet give us the possibility of deducing our facts and dimensions, We move on to the third level (level3), which is an operational level, by decomposing each tactical goal into informational goals (figure 3).
In the process 2 of the DNE approach expressed in the previous section, the DN will be classified according to these levels of abstraction, from which the goals will be classified into three categories: strategic, tactical and informational, after grouping the list of the strategic goals and associate or / and decompose them into a list of tactical goals that will be, in turn, attached to a list of informational goals.

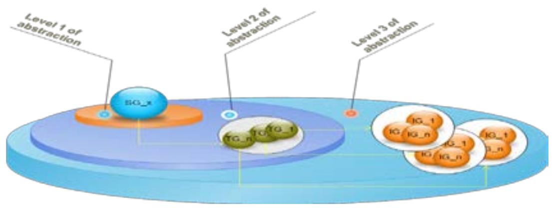

Fig.3 Levels of abstraction of a goal

Each DN is decomposed into a set of strategic goals (SG), and for each strategic goal i, we present it as a set of tactical goals (from 1 to n),

We have $DN = \sum_{i=1}^{n} SG\ i$ (1)

Such as :

$SG\ i = \sum_{j=1}^{n} TG\ j$ (2)

And for every tactical goal j of the strategic goal i, it is, itself, presented as a collection of informational goals (from 1 to m), we have:

$TG\ j = \sum_{k=1}^{m} IG\ k$ (3)

To model the abstraction levels of a decisional need, we define the following model (Table 1):

Table 1: Goal classification model by level of abstraction.

Decisional need x: DN code		
Strategic goal x	Tactical_goal_x_1	Informational_goal_x_1_1
		...
		Informational_goal_x_1_m
	...	...
	Tactical_goal_x_n	Informational_goal_x_n_1
		...
		Informational_goal_x_n_m

3.2 Model of decomposition of the decisional goals in Result / Canal

Each goal will be divided into result and canal in order to treat it easily, Each result is decomposable into actions and each canal is decomposable into means and manners.

Result = $\sum_{i=1}^{n} Action\ i$ (4)

And Canal = $\sum_{i=1}^{n} Means\ i + \sum_{j=1}^{m} Manner\ j$, (5)

This relation is represented in the form of a meta-model which explains our structure of the decision-maker's goal (Figure 4).

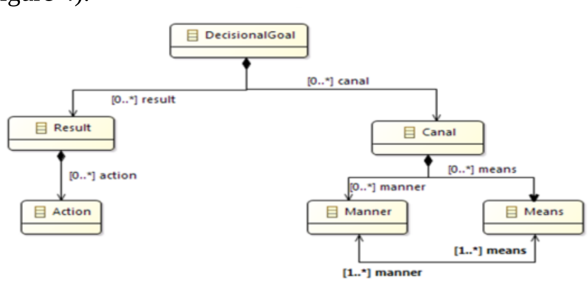

Fig.4 Structure of a decision-maker goal as a function of time and context

To express the decisional needs in Result and Canal, we propose this model of representation (Table 2).

Table 2. Decomposition model of the decisional goals

Goal : X		
Result	Canal	
	Manner	Means
Action 1 ... Action n	1. Manner 1 .... n. Manner n	1. Means 1 ... n. Means n

3.3 Building the relations' matrix

The analyst-designer can represent the links between the goals of the same type by matrices of the relations between the Types Goals {Strategic / Tactical / Informational} (Table 3).

Table 3. Model of the relations' matrix between the Types goals {Strategic / Tactical / Informational}

Type Goal(TG)	TG 1	TG 2	...	TG n
TG 1		C/⌐C	...	C /⌐C
TG 2	R/⌐R/		...	C/⌐C
...	...	...		...
TG n	R/⌐R/	R/⌐R/	...	

In this matrix we put the list of the Types goals in rows and the same list in columns, then we compare the result of each goal i compared to the results of the other goals j (such as i # j), this result can be the same (R) If the actions that composed the two goals (i and j) are the same or different(⌐R) if we have the opposite case.

3.4 Application of the treatment rules of the decisional goals on the relations' matrix

To treat the matrix of the relations between the Types goals, the assistance of a business expert with the analyst-designer is desired. In the rest of this section we propose the Goals' Treatment Rules (GTR) that we have defined:

Main rules:

In the remainder of this method, we put:

- Result (TypeG i) = Result (TypeG j) (such as i # j) is defined by a loop that tests the set of actions that compose Result (TypeG i) with the set actions of Result (TypeG j).
- Canal (TypeG i) = Canal (TypeG j), is defined by several loops which make it possible to test all means and manners of Canal (TypeG i) with all means and manners of Canal (TypeG j). With " TypeG ": Type Goal {Strategic Goal, Tactical Goal or Informational Goal}

A. Strategic Goals' Treatment Rules (SGTR)

SGTR1:

If Result (SG i) = Result (SG j) (as i # j) AND Canal (SG i) = Canal (SG j) then the analyst-designer must:

- Choose one of the goals to keep and delete the other.

- Add the tactical goals of SG to be removed to the other (SG) that we must keep, eliminating duplicates for each TG.
- Add the informational goals of SG to be removed to the other (SG) that we must keep, eliminating duplicates for each IG.

SGTR2:
if Result(SG i) = Result(SG j) (as i # j) AND Canal(SG i) # Canal(SG j) then the analyst-designer must:

- Concatenate the two strategic goals into a sole global one.
- Merge the tactical goals of the two strategic goals, eliminating duplicates for each TG.
- Merge informational goals of the two strategic goals, eliminating duplicates for each IG.

SGTR3:
If Result(SG i) # Result(SG j) (as i # j) as Result(SG i) ∩ Result(SG j) = Result(SG j) OR Result(SG i) ∩ Result(SG j) = Result(SG i) then the analyst-designer must:

- Keep the strategic goal that have the most general result.
- Merge the tactical goals of the strategic goal to be removed with the tactical goals of the strategic goal to be kept, eliminating duplicates for each TG.
- Merge the informational goals of the strategic goal to be removed with the informational goals of the strategic goal to be kept, eliminating duplicates for each IG.

SGTR4:
If Result(SG i) # Result(SG j) (as i # j) as Result(SG i) ∩ Result(SG j) = $\emptyset$ OR Result (SG i) ∩ Result(SG j) = Result less than Result(SG j) and less than Result(SG i) then the analyst-designer must:

- Keep both strategic goals.

B. Tactical Goals’ Treatment Rules (TGTR)

TGTR1:
If Result (TG i) = Result (TG j) (as i # j) AND Canal (TG i) = Canal(TG j) then the analyst-designer must:

- Choose one of the goals to be kept and delete the other.
- Add the informational goals of TG to be removed to the other (TG) that we must keep, eliminating duplicates for each IG.

TGTR2:
If Result (TG i) = Result (TG j) (as i # j) AND Canal(TG i) # Canal(TG j) then the analyst-designer must:

- Concatenate the two tactical goals into a sole global one.
- Merge the informational goals of the two tactical goals, eliminating duplicates for each IG.

TGTR3:
If Result(TG i) # Result(TG j) (as i # j) as Result(TG i) ∩ Result(TG j) = Result(TG j) OR Result(TG i) ∩ Result(TG j) = Result(TG i) then the analyst-designer must:

- Keep the tactical goal that have the most general result.
- Merge informational goals of the tactical goal to be removed with the informational goals of the tactical goal to be kept, eliminating duplicates for each IG.

TGTR4:
If Result(TG i) # Result(TG j) (as i # j) as Result(TG i) ∩ Result(TG j) = $\emptyset$ OR Result (TG i) ∩ Result(TG j) = Result less than Result(TG j) and less than Result(TG i) then the analyst-designer must:

- Keep both tactical goals.

C. Informational goals’ Treatment Rules (IGTR)

IGTR1:
If Result (IG i) = Result (IG j) (as i # j) AND Canal (IG i) = Canal (IG j) then the analyst-designer must:

- Choose one of the goals to be kept and delete the other.

IGTR2:
if Result(IG i) = Result(IG j) (as i # j) AND Canal(IG i) # Canal(IG j) then the analyst-designer must:

- Concatenate the two informational goals into a sole a global one.

IGTR3:
If Result(IG i) # Result(IG j) (as i # j) as Result(IG i) ∩ Result(IG j) = $\emptyset$ OR Result (IG i) ∩ Result(IG j) = Result less than Re-sult(IG j) and less than Result(IG i) then the analyst-designer must:

- Keep both informational goals.

IGTR4:
If Result(IG i) # Result(IG j) (as i # j) as Result(IG i) ∩ Result(IG j) = Result(IG j) OR Result(IG i) ∩ Result(IG j) = Result(IG i) then the analyst-designer must:

- Keep the informational goal that have the most general result.
- Reference: it is the entity according to which an action, of the fact table, is performed or a state is achieved or maintained (e.g., Adjust (Action) the SMS price (Object) to the minimum price of the competitors (Reference)).
- To retrieve fact table and its measurements associated with the indicators on the facts, two types of indicators are to be considered:
- Indicators on the fact table: The name of the fact table can be inferred from the "Action" indicator and the "object" element of the "Target" indicator.

4. Example of implementation

On the basis of the previous section, to implement this work, we propose this meta-model which represents the internal structure of the decisional goal (fig.5).

4.1 Our meta-model

In this meta-model, the main class is "Abstract goal", each decisional goal is represented by its name and is divided into two categories:

- Composite category: Two goals inherit this one: The strategic goal and the tactical goal, and each one of the two types of goals can be decomposed into several goals; the strategic goal is divided into the tactical goals and the tactical goal into the informational goal.
- Simple category: from which it inherits the informational goal since it is no longer more decomposable, it is an operational goal.

In the meta-model, we decompose "Abstract Goal" into a single Result and into a single canal. And the result is decomposable into one or more actions, thus the canal is decomposable into several means and into several manners.

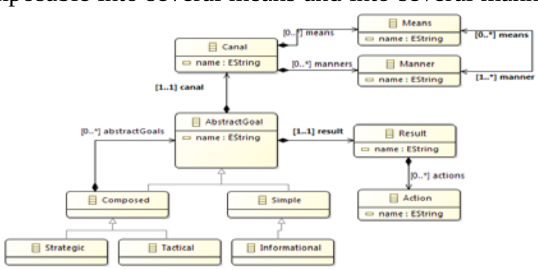

Fig.5 Meta-model of a decisional goal

4.2 Validation of the meta-model

To validate our meta-model, we must instantiate it with models, we propose the example below:

From this classification we will treat all the goals by type (Strategic, then tactical and finally informational).

We take a goal and we will divide it into Result / Canal, in our case, we have the following informational goal:

IG1= Increase the amount of sales of tablets for a customer category subsidiaries located in Morocco, by offer promotions and by reduction of prices compared to competitors, in a period of seven months.

We put the goal in the model of decisional goal decomposition, which we have proposed:

Table 4. Example of a need classified in goals by level of abstraction

Strategic goal	Tactical goal	Informational goal
1. Strengthening price image by reducing the cost of tablets	1.1. Attract more customers by offer promotions	1.1.1. Evaluate promotions and their effectiveness by region, city, country
		1.1.2. Evaluate promotions by tablet brand
		1.1.3. Evaluate promotions by type of promotion
		1.1.4. Measure promotions and their effectiveness by size
	1.2. Attract more customers using the proposal of the "price warning" range in subsidiaries	1.2.1. Analyze sales by customer segment
		1.2.2. Evaluate promotions and their effectiveness by region, city, country
		1.2.3. Evaluate the number of customers by region, city, country
		1.2.4. Measure sales by subsidiary
		1.2.5. Analyze sales by tablet brand

This example, we can use it as model for instantiate our meta-model, and as result, we have the following diagram (Figure 6):

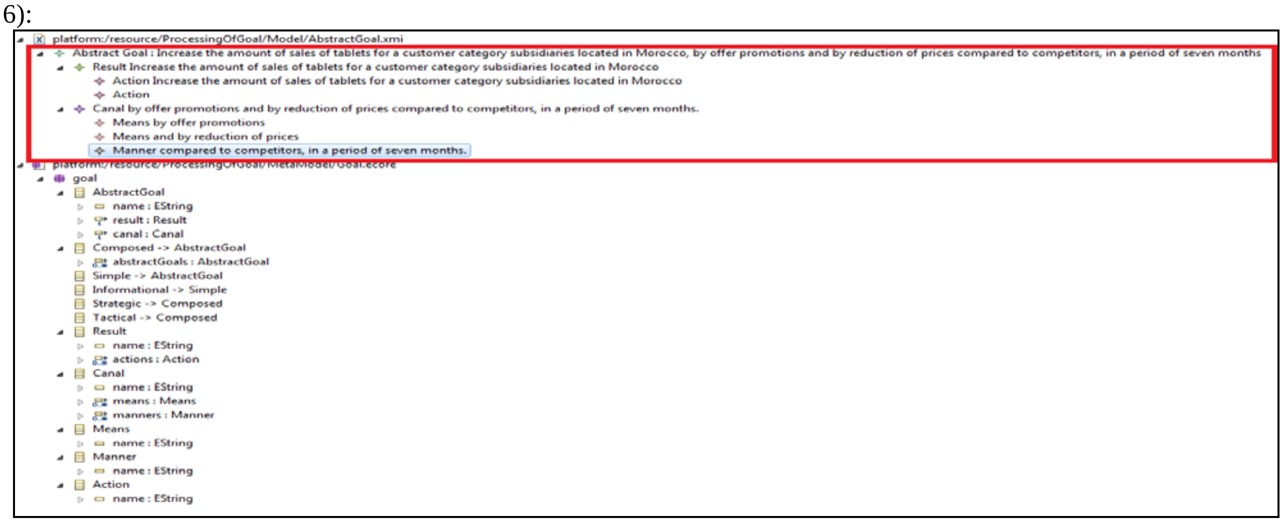

Fig.6 An instantiation model of our meta-model

4.3 Application of treatment rules

On the basis of the goals' treatment rules, an activity diagram is given in the following section, which represents an example to treat the strategic goals (idem for the others, see figure 7).

We put :

i # j

DN = $\sum_{i=1}^{n} SGi$

$SG\ x = \sum_{i=1}^{m} TG\ i$

such as $TG\ i = \sum_{k=1}^{m2} IG\ k$

Result = $\sum_{i=1}^{n} Action\ i$

Canal = $\sum_{i=1}^{n} Means\ i + \sum_{j=1}^{m} Manner\ j$

5. Conclusion

In this article, we have firstly presented a state of the art of the DIS needs' analysis approaches (represented by the DNE approaches), the models proposed for the DN representation, and finally the treatment process of these DN. We have been thus able to identify the problems encountered in the DN treatment process. In a second step, we have defined the levels of abstraction of the needs expressed by the decision-makers to decompose and classify them. These abstraction levels are of three types: strategic, tactical and informational. The integration of the Result / Canal concept, as a new structure for the decomposition of these decisional goals, constitutes the originality of our work, expressing the result in the form of one or more actions and the canal in the form of one or more Means and one or more manners. From this notion of Result / Canal, we have established our matrices of relations between the goals of the same level of abstraction.

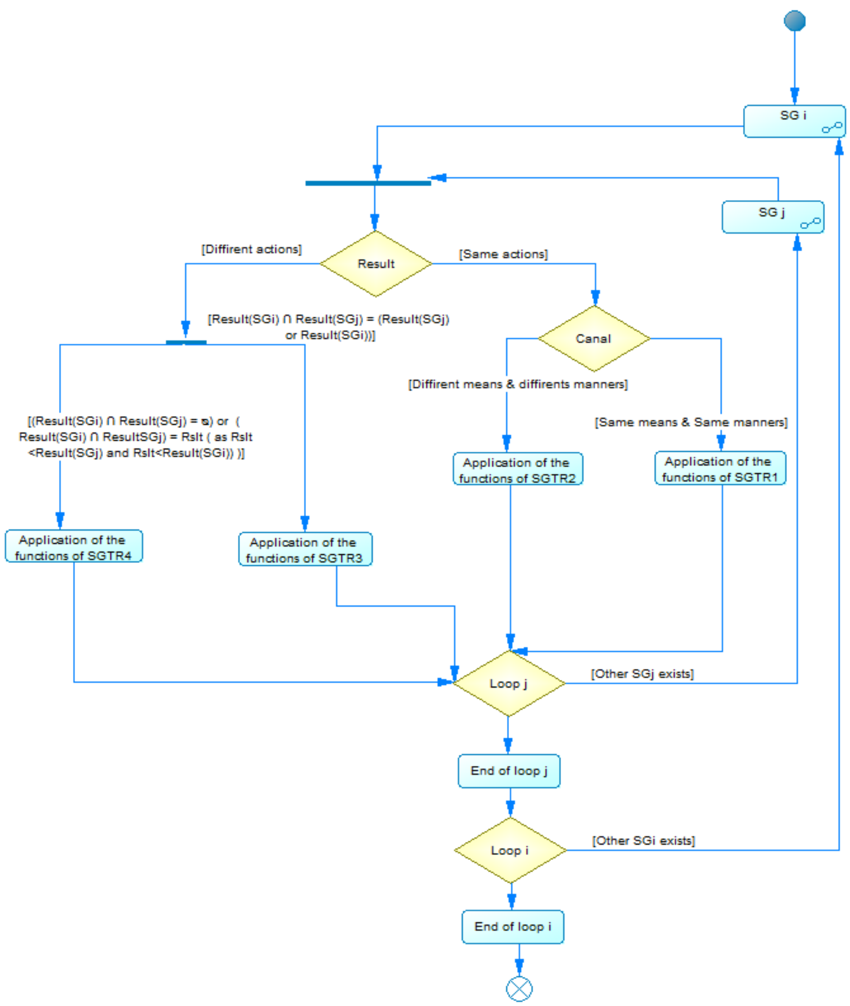

Fig.7 An activity diagram to treat the list of strategic goals by applying our treatment rules

To treat these matrices, we have defined a set of rules in the form of an method.

We have also built models that accompany every step of the proposed treatment process of the DN. These models ensure the consistency of the process and the sequence of the steps. Thus, the analyst-designer will be guided throughout the DN treatment process.

To complete this work, we wish to develop a model for the formalization of the informational goals which will serve to systematically extract the indicators on the facts and the indicators on the dimensions, these indicators are essential for the establishment of the table of decisional data which will be the basis of our star schema. We also plan to implement a development tool that supports the various phases of this DNE process and this method as a part, this tool will guide the analyst-designers of a DIS, in the discovery of the decision-makers' needs.

Acknowledgments

I acknowledge the support provided by my supervisors: Pr. Abdelmounaim ABDALI and Pr. Noureddine ZAHID and the members of the laboratory LAMAI (Laboratory of Mathematics Applied and Informatics) of the Faculty of Science and Technology-Cadi Ayyad University-Marrakesh.

References

[1] P. Bourque and D. Fairley, “Guide to the Software Engineering Body of Knowledge, ” 3rd Edition, IEEE, 2014.

[2] D. L. Moody and M. A. R. Kortink, “From enterprise models to dimensional models: a methodology for data warehouse and data mart design”. In Jeusfeld, 2000.

[3] B. Husemann, J. Lechtenborger, and G. Vossen. “Conceptual data warehouse modeling, ”. In Proc. DMDW Stockholm, Sweden, 2000, pp. 6.1--6.11.

[4] R. Kimball, L. Reeves, W. Thornthwaite, M. Ross, and W. Thornwaite. “The Data Warehouse Lifecycle Toolkit : Expert Methods for Designing”. John Wiley & Sons, Inc., New York, NY, USA. 0471255475, 1998.

[5] L. Carneiro, and A. Brayner. “X-META : A methodology for data warehouse design with metadata management”. In Design and Management of Data Warehouses (DMDW), pages 13–22, 2002.

[6] A. Bonifati, F. Cattaneo, S. Ceri, A. Fuggetta, and S. Paraboschi. “Designing data marts for data warehouses”. ACM Trans. Softw.Eng. Methodol.,10(4) :452–483, 2001.

[7] E. Annoni, “Eléments méthodologiques pour le développement des systèmes décisionnels dans un contexte de réutilisation”, PhD thesis, University of Toulouse 1, Toulouse, France, 2007.

[8] A. Sabri, and L. Kjiri, “ Une approche d'Ingénierie des Besoins Décisionnels pour la conception d'Entrepôts de Données dans un contexte de réutilisation”, PhD thesis, University Mohammed V of Rabat (ENSIAS, Rabat), Morocco, March 28, 2015.

[9] J.-N Mazon, J. Trujillo, M. Serrano, and M. Piattini, “Designing data warehouses: from business requirement analysis to multidimensional modeling”, Proceeding of the 13th IEEE International Requirements Engineering Conference Workshop on Requirements Engineering for Business Needs and IT Alignment (REBNITA), Paris: August 2005.

[10] S. Lujàn-Mora, and J. Trujillo, “A comprehensive method for data warehouse design”, Proceeding of the 5th International Workshop on Design and Management of Data Warehouses, DMDW'03 , Berlin, Germany, September 2003.

[11] I. Gam El Golli, “Ingénierie des Exigences pour les Systèmes d'Information Décisionnels : Concepts, Modèles et Processus (la méthode CADWE)”, PhD thesis, University Paris-Panthéon-Sorbonne, France, October 2008.

[12] F. Abdelhédi, and G. Zurfluh, “User Support System for Designing Decisional Database”, ACHI 2013: The Sixth International Conference on Advances in Computer-Human Interactions, Nice, France: 24 Feb. - 1 Mar. 2013.

[13] F. Bargui, J. Feki, , and H. Ben-Abdallah, “A natural language approach for Data Mart schema”, NLDB'09: Proceedings of the 14th international conference on Applications of Natural Language to Information System, Saarland University, Saarbrücken, Germany: 23-26 June 2009.

[14] J. M. Cavero, M. Piattini, and E. Marcos, “Midea : A multidimensional data warehouse methodology”, In ICEIS, pages 138–144, 2001.

[15] J. Feki, H. Ben-Abdallah, and M. Ben-Abdallah, “Réutilisation des patrons en étoile”, INFormatique des ORganisations et Systèmes d'Information et de Décision (INFORSID 06), 31 mai- 4 june, Hammamet, Tunisie, 2006.

[16] C. Phipps, and K.C. Davis, “Automating data warehouse conceptual schema design and evaluation”, In Proc. of the International Workshop on Design and Management of Data Warehouses (DMDW'2002), Toronto, Canada,vol.58, pp.23-32, 2002.

[17] F. Ghozzi, F. Ravat, , O. Teste, , G. Zurfluh, “Méthode de conception d'une base multidimensionnelle contrainte”, Revue des Nouvelles Technologies de l'Information – Entrepôts de Données et l'Analyse en ligne (EDA'05), Cépadues éditions, volume RNTI-B-1, pages 51–70, 2005.

[18] N. Prakash, , A. Gossain, “Requirements driven data warehouse development”, The 15th Conference on Advanced Information Systems Engineering (CAiSE'03), Klagenfurt/Velden, Austria: 16-20 June 2003.

[19] M. Tawbi, F. Velez, C. BenAchour, and C. Souvey, “Scenario Based RE with CREWS-L'Ecritoire: Experimenting theapproach”, ESQ'2000, Sixth International Workshop on Requirements Engineering: Foundation for Software Quality, Stockholm, Sweden, June 5-6 2000.