

# Resource Modeling for the Establishment of a Decision-Making System Applied to HCEFLCD of Morocco

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## Abstract

The aim of this work is to develop a decision support system for the operation of a model including the main stakeholders of the High Commissioner for Water, Forests and Desertification Control (maker / managers, administrative, customers). This system is based on the relationship between the actors and their activities and their needs vary by contribution in time. It AIMS to make available to managers a set of dashboards that can improve the quality of services provided. We begin by modeling the actors up and clean process for studying Both Their organisms and their activities and needs. The first applications of this work HAD focused on data for the Directorate of Planning, Information System and Cooperation, and Cooperation, and the Directorate of Forest Estate, Legal Affairs and Litigation. The results are encouraging.

**Keywords:** Information systems, decision support systems, dashboards, databases, modeling.

## INTRODUCTION

Nowadays Business intelligence is one of the fast growing area of computer science. Indeed, the managers of activities, facing increasingly unstable environments, are expected to take the most effective decisions based on reliable data. The current problem is not to have a better decision tool, but to effectively structure upstream data. Thus, the design of evolutionary decision-making information systems is a current issue for all organizations around the world.

Today HCEFLCD assigned missions require not only to be attentive to the needs of its users / decision-makers, but also to anticipate these needs by acting as "company. Also the business intelligence becomes a necessity for the management system for the Moroccan HCEFLCD.

This work falls under this context and calls for the design and implementation of a decision support system dedicated to HCEFLCD [7]. The goal is the modeling of actors that takes into account their activities and their needs. In doing so, it

aims to give a complete and accurate description of all aspects of actors behaviors and provide dashboards to facilitate decision-making [8]. The adopted model reflects a true picture of the system and uses UML as a current standard in the world of the information systems design.

## ASSUMPTIONS

Due to its geographical position and its diverse Eco-regions, Morocco has rich and diverse forest ecosystems, which always played, environmental as well as socioeconomic roles determinants in local and regional development.

Moroccan forest ecosystems with an area of about 9 million hectares (5.8 million wooded hectares) are subject to Mediterranean climate, characterized by the scarcity of water for a good time of year. This severely limits the growth of forest trees. Indeed, these ecosystems are facing major challenges, including:

- The restoration and research of new ecological balances and management methods consistent with the physical, economic and socio-cultural conditions.
- The conservation of water resources through the control of land degradation
- In watersheds and protecting their natural abilities and hydro-agricultural infrastructures.
- An understanding of the extent and rate of desertification and degradation of biodiversity through integrated and complementary interventions.
- The setting-up of the integrated development of the cultivation of forest areas and perished forests seeking new sources of income to reduce the pressure on these resources and ensuring their sustainable development in order to ensure the diversity of roles of these spaces.

This strategic vision of the HC which is based on a set of studies and sectorial plans on the management of watersheds,

reforestation, the fight against desertification and protected areas could be translated into operational programming of the ten-year program (2005-2014) by adopting a territorial, partnership and broad consultation. And by adapting and rendering the 10-year program into 3year program whose implementation is ensured by the regional offices and provincial services of HCEFLCD, through regionalized annual contract programs and on the basis of new governance based on the four tenets: the project, responsibility, contracting and result.

**CONTEXT**

As part of the automation of the High Commission for Water and Forests and the Fight against Desertification work processes, the development of a contentious case management application has a high added-value project. So it has been a subject matter at the 3rd edition of the scientific day of information processing systems analysis.

Indeed, this application allows foresters/forest rangers to enter VPs once an offense is committed with all related details, attach a scanned PV and keep track of the case. Thus, an official in charge found elsewhere, according to his profile, will have a visibility on the details of the current situation

based on a search engine following criteria and graphs. This is through the local network or internet. This instantaneous management enables better decision support.

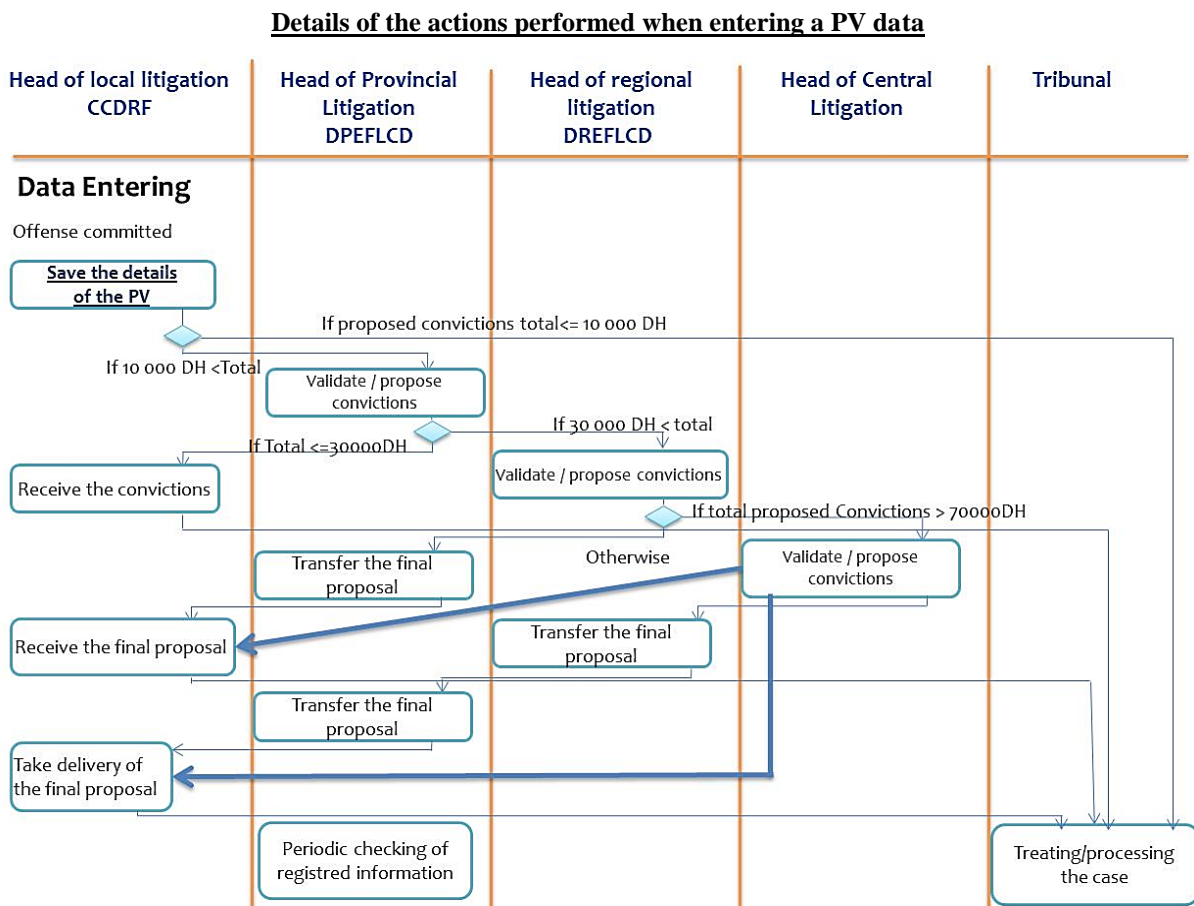
Today, the Moroccan High Commission for Water and Forests and the Fight against Desertification stirs in its information system a large volume of data and information. [2] Often, within this volume, it becomes difficult to make sense of this data and have accurate and reliable indicators. So we can group /gather our data according to this model into three levels:

1. **Stakeholder level:** two types of decision makers namely field officers and provincial directors.
2. **Administrative level:** Database on the administrative status of all stakeholders.
3. **Basis of regulations:** Regulations and Rights of each operator.

**MODELING ACTORS**

In order to better understand and analyze the performances of the provincial directorates in the legal activity: the follow-up of the PV penal distinguishes between two major phases: The entering and the follow-up of the PV.

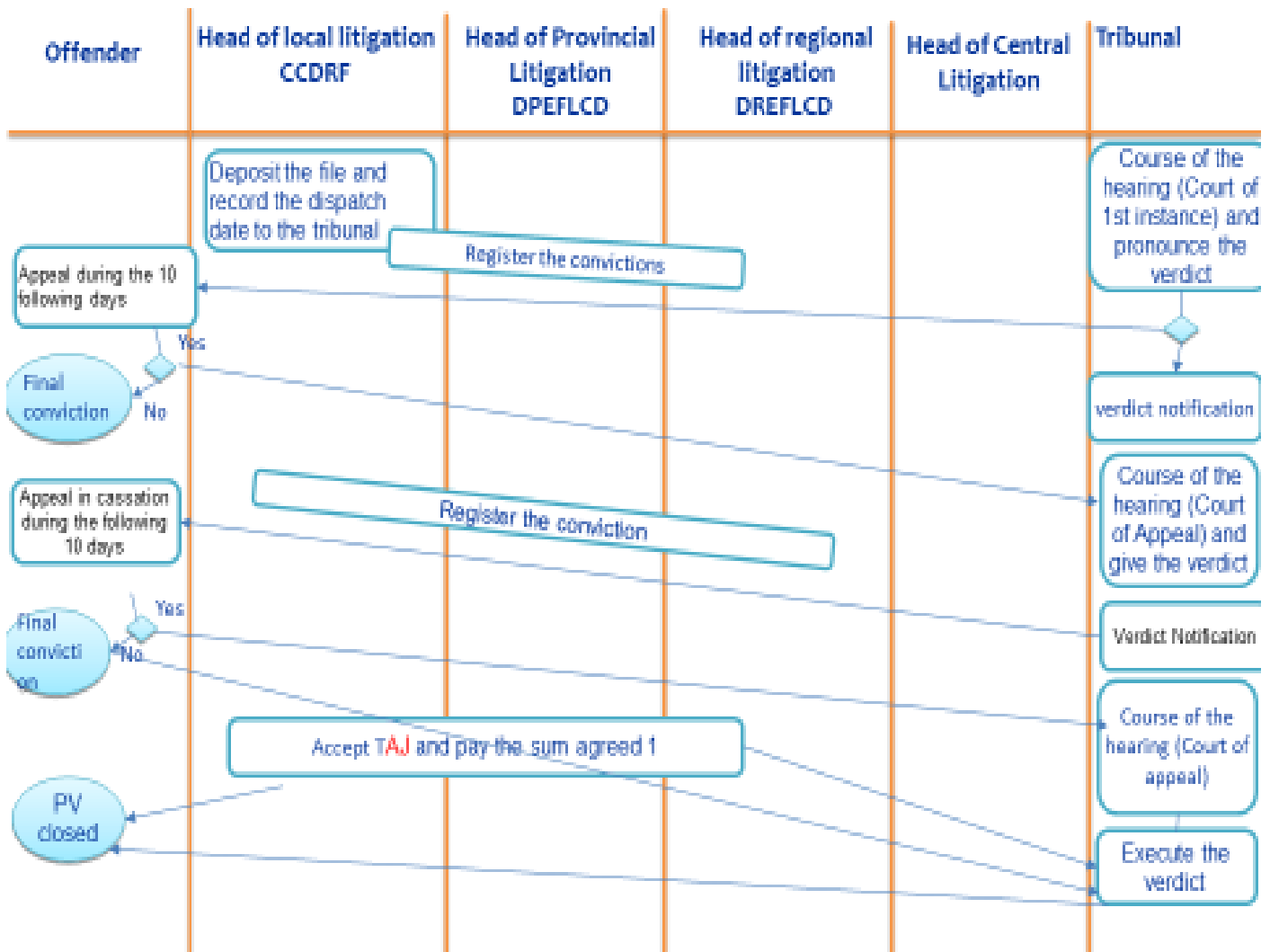
We can schematize the two processes as follows:



**Follow up of the case file :**

Who	What	When	How: application
<b>CCDRF</b>	Power/feed the system by the data recorded at the level of a <b>PV</b> paper (dates, location, offenders, nature ...) in order to allow the users at higher levels to have the information in real time.	Once the PV received	Add a new PV and then feed the tabs: PV of offenses committed, sending and return of the PV, detail PV, Digital PV
	Search for and consult a given PV and then <b>edit</b> an overview/outline in order to quickly know the detail of a given PV	If the case appears	Search Filter: 1st page of the application Action -> Overview
<b>DPEFLCD</b>	Check if the pv exists at the level of the application. If NO => Contact the responsible of the litigation at the level of the CCDRF to register it. If YES => mention the reception at the level of the application. and enter proposed convictions by the DPEFLCD Objective: To update or validate the amounts of convictions proposed in the HCEFLCD	Once the PV received	Search Filter: 1st page of the application  Click on the PV at the level of the list -> sending receipt of the PV PV details -> proposed convictions
	To search and consult a given PV then to publish an overview in order to quickly know the details of a given PV	If this is the case	Search Filter: 1st page of the application Action -> Overview
	Edit the monthly state of the previous month and compare the number of PVS registered at the level of the application with the number of PVS mentioned at the level of the monthly paper state sent by the ccdrf. If the number is not the same, contact the responsible of the litigation at the level of the ccdrf to enter the PVS. Objective: To ensure that the number of PVS entered at the level of the application is equivalent to that of paper	Each 1st week of the month	Editions -> Monthly Situation
<b>DREFLCD</b>	Save the receipt of a PV as well as proposed convictions by the DREFLCD Objective: To update or validate the amounts of convictions proposed by HCEFLCD	Once the PV received	Pv details -> proposed convictions
	Search for and view a given PV and then edit an overview in order to quickly know the detail of a given PV	If this is the case	Search Filter: 1st page of the application Action -> Overview
<b>Central</b>	Save the reception of a PV as well as proposed convictions by the Central Management Objective: To update or validate the amounts of proposed convictions by the HCEFLCD	Once the PV received	Click on the PV at the level of the list -> sending receipt of the PV PV details -> proposed convictions
	Search for and consult a given PV and then edit an overview in order to quickly know the detail of a given PV	If this is the case	Search Filter: 1st page of the application Action -> Overview

**Details of the actions performed during the follow-up of the case**



Who	What	When	How: application
CCDRF	Enter the details of the following actions, transmission to the court (various levels), Taj, verdict and its enforcement  <b>Objective:</b> Mention the case status in order to be able to facilitate the monitoring of the PVS	Once action is proceeded	Feed the accessible pages from the following path: list of PVS->Action->TAJ/monitoring judgment
	<b>Edit</b> the graph of the PVS forwarded to the court for the PVS having exceeded 3 months.  <b>Objective:</b> Check that all the PVS were well transmitted to the courts without omission.	Each 1st week of the month	Statistics -> Graphs -> PVs transmitted to the court
	at 1st week of each quarter publish the graph of judged/performed offenses for the PVS whose recording Date of exceeds the 8 months. If the percentage of PVS not yet tried /executed is large enough, activate the follow-up to the courts.  <b>Objective:</b> To enable the follow-up to the courts.	Each 1 st week of the quarter	Statistics -> Graphs -> PVs judged Statistics -> Graphs -> PVs executed

<b>DPEFLCD</b>	Edit the graph of the PVS transmitted to the court by ccdrf. If the percentage of PVS transmitted is Low => malfunction: It is necessary to contact the responsible of the litigation at the level CCDRF concerned and resolve the problem.  <b>Objective:</b> To check that the whole of the PVS have been transmitted to the courts and find the source of the problem where appropriate in order to take the right decisions	Each 1st week of the month	Statistics -> Graphs -> PVs transmitted to the Tribunal by Entity
	Edit the the graph of judged/performed offenses at the 1st week of each quarter by CCDRF for the PVS whose recording Date exceeds the 8 months. If the percentage of not yet tried /executed PVS is large enough => malfunction. It is necessary to contact the responsible of the litigation at the level of the CCDRF to see where it is blocked/obstructed.  <b>Objective:</b> Locate the CCDRFs where there are more problems of follow-up at the level of the courts and analyze that in order to discuss the problem with the entities concerned and take the right decisions	Each 1 st week of the quarter	Statistics -> Graphs -> PVs judged by entity Statistics -> Graphs -> PVs executed by Entity

### TRADITIONAL CLASSIFICATION METHOD

After a system implementation for 3 years, we collected a data containing all the information on this activity but whose processing remains ineffective, However, we have distinguished three types of critical and important information to classify directorates according to their performance: Number of recorded PVs, PV Number sent to court and executed PVs as shown below:

Year	Recorded PVs			Transmitted PVs			Deemed PVs		
	2013	2014	2015	2013	2014	2015	2013	2014	2015
PR1	132	160	121	67%	70%	80%	0%	0%	0%
PR2	814	938	810	40%	46%	32%	8%	8%	1%
PRO3	704	930	810	34%	62%	38%	3%	1%	0%
PRO4	22	20	10	73%	60%	10%	5%	0%	0%
PRO5	694	987	432	38%	30%	65%	0%	0%	0%

Indeed to assess the performance of provincial offices, we will define the variable **Moy (Pv\_enr)** which represents the average of PV registered during the three last years.

The goal is to find a technical means for classifying the provinces to help those in difficulty of litigation management by taking the best practices from those top ranked.

The classification of the provinces according to the value of the **Moy (PV\_enr)** illustrates the ability of technicians to perform well. To standardize and categorize the value **Moy (PV\_enr)**, we will define for each province the categorization

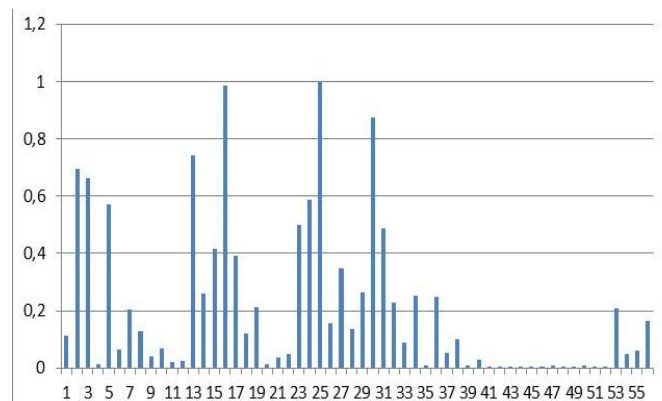
of report of the Moy (Pv\_enr) below:

$$NMoy(Pv\_enr)$$

Moy (Pv\_enr): pvs average recorded during the three years.

Max (Avg (Pv\_enr)): the maximum value of Av (Pv\_enr) on all provinces.

This ratio will obviously always less than or equal to 1, but it gives us an idea on the activity report of field agents. Thus, the graph N Moy (Pv\_enr) for the 55 provinces is as follows:



**Figure 1:** Ratio N Moy (Pv\_enr) by province for the years 2013-2015

To make the connection between the N Moy (PV\_enr) and activity of enforcement officers, we propose the following Qualifying:

Indicator	Operator	Margin	Classe de Moy(PV_ enr)	RANGERS ACTIVITIES
NMoy(PV_ enr)	<	0	Categ1	Terrible
	Between	[0 - 0.2[	Categ2	Very weak
	Between	[0.2 - 0.4[	Categ3	Weak
	Between	[0.4 - 0.6[	Categ5	Average
	Between	[0.6 – 0.8[	Categ6	Good
	Between	[0.8 – 1]	Categ7	Very good

**Table 1:** The result of the traditional classification of 55 provincial directorates according to class of LAvg (Pv\_ enr)

Provincial directorats	Moy(Pv_ enr)	NMAX	category
Meknes El hajeb	137,666667	0,11192412	2
Khénifra	854	0,69430894	5
Ifrane	814,666667	0,66233062	5
Errachidia	17,3333333	0,01409214	2
Midelt	704,333333	0,57262873	4
Nador	77,3333333	0,06287263	2
Taurirt	249,666667	0,20298103	3
Jerada	159,333333	0,1295393	2
Berkane	51,3333333	0,04173442	2
Figuig	84,6666667	0,06883469	2
Oujda	25,6666667	0,02086721	2
Driouech	28,6666667	0,02330623	2
Kénitra	916	0,74471545	5
Sidi slimane	321,333333	0,26124661	3
Rabat	511,666667	0,41598916	4
Khémisset	1212	0,98536585	6
Khouribga	480,666667	0,39078591	3
Benslimane	148,333333	0,12059621	2
Settat	262	0,21300813	3
Casablanca	14	0,01138211	2
Safi	47,6666667	0,03875339	2
El Jadida	60,6666667	0,04932249	2
Azilal	613,333333	0,49864499	4
Béni Mellal	720,666667	0,58590786	4
Chefchaouen	1230	1	6
Tétouan	192,333333	0,15636856	2
Larache	427	0,34715447	3
Tanger	167,666667	0,13631436	2
Ouazzane	324,666667	0,26395664	3
Al Hoceima	1078	0,87642276	6
Taounate	597,666667	0,48590786	4
Taza	281	0,22845528	3

Guercif	110	0,08943089	2
Sefrou	311,333333	0,25311653	3
Fes	12,3333333	0,0100271	2
Boulemane	304,333333	0,24742547	3
Agadir	64,6666667	0,05257453	2
Taroudant	125,333333	0,10189702	2
Tiznit	13,3333333	0,01084011	2
Chtouka Aït Baha	37,6666667	0,03062331	2
Ouarzazate	5	0,00406504	2
Zagora	1,33333333	0,00108401	2
Sidi Ifni	8	0,00650407	2
Tinghir	8	0,00650407	2
Dakhla	2,66666667	0,00216802	2
Boujdour	1	0,00081301	2
Laayoun	8,66666667	0,00704607	2
Es-Smara	5,66666667	0,00460705	2
Tan tan	1	0,00081301	2
Guelmim	11,3333333	0,00921409	2
Assa Zag	1,33333333	0,00108401	2
Tata	1	0,00081301	2
Marrakech	254,666667	0,20704607	3
Chichaoua	62	0,0504065	2
El Kalâa	73	0,05934959	2
Es-Saouira	203,666667	0,16558266	2

The classification/ categorization of the provincial directorates, regardless of their transmission rate to court and verdicts execution, remains in complete and distort their litigation management.

However, the classification will be relevant only if we take into account two factors: the rate of transmission to the court and the ability to enforce verdict

So to better judge/evaluate the ability of management and follow-up of the PV penal of regional branches, we will invoke later in this article to a segmentation classification technique (clustering) as a good grouping method that can ensure: a great similarity intra-group and low inter-group similarity.

Indeed, the quality of a group depends on the similarity measure used by the method and its implementation. We then move from a data matrix

$$\begin{bmatrix} x_{11} & \dots & x_{1f} & \dots & x_{1p} \\ \dots & \dots & \dots & \dots & \dots \\ x_{i1} & \dots & x_{if} & \dots & x_{ip} \\ \dots & \dots & \dots & \dots & \dots \\ x_{n1} & \dots & x_{nf} & \dots & x_{np} \end{bmatrix}$$

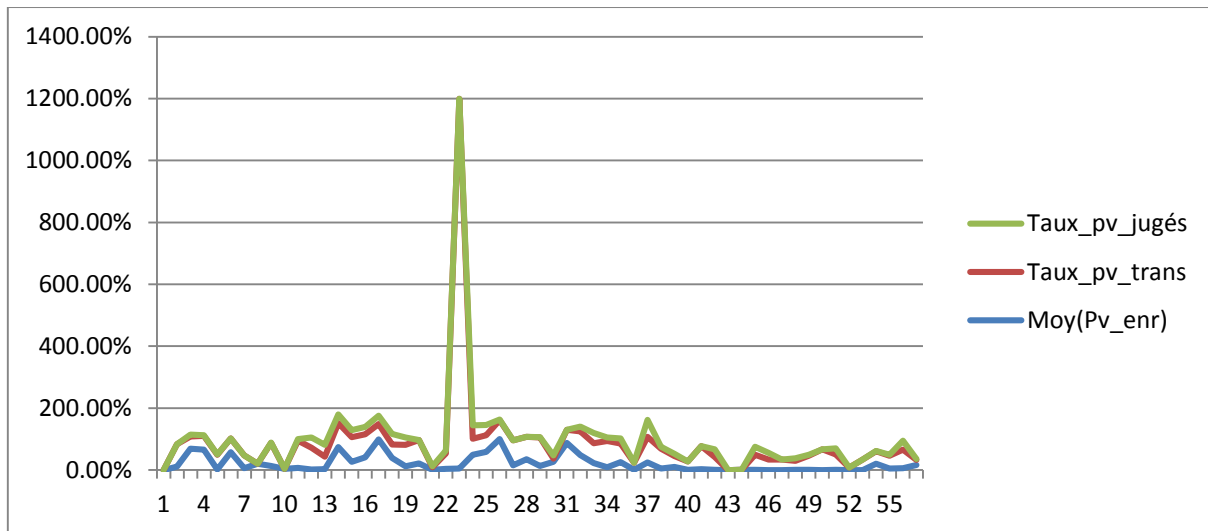
to a similarity matrix

$$\begin{bmatrix} 0 & & & & \\ d(2,1) & 0 & & & \\ d(3,1) & d(3,2) & 0 & & \\ \vdots & \vdots & \vdots & & \\ d(n,1) & d(n,2) & \dots & \dots & 0 \end{bmatrix}$$

Recognizing this, we will define each provincial directorate with three dimensions, average registered pvs and transmitted PV rate to court and judged pvs. We then define the DR matrix (Avg (Pv\_enr) Taux\_pv\_trans, Taux\_pv\_jugés)

The following graph describes the presentation of three dimensions by provincial directorates:





**Figure 2:** Presentation of the three dimensions: average of PVS registered, rate of PVS transmitted to the court, and rates of PVS treated by provincial directorates

## PRESENTATION OF THE SUGGESTED METHOD

### The k-means algorithm

The k-means algorithm is a simple but popular form of cluster analysis. The basic idea is that you start with a collection of elements (e.g. genes) and a selected number of clusters (k) you want. The elements are initially randomly assigned to a cluster. K-means clustering is repeated product of a two-step process where:

1. The mean vector for all the elements of each group is calculated
2. The items are assigned to the cluster whose center is close to the item.

The initial assignment of the cluster is random, different tracks of the k-means clustering algorithm cannot give the same final clustering solution. To address this, the k-means clustering algorithms are repeated several times, each time from a different initial consolidation. The sum of the distances within clusters is used to compare clustering solutions of different regrouping. The clustering solution with the smallest sum of the intra-cluster distances is recorded.

The number of iterations that should be done for the solution to be optimal, in turn depends on the number of genes involved. Cluster therefore shows in the status bar how many times the optimal solution was found. If the number is one, there may be a clustering solution with an even lower amount of intra-cluster distances. The k-means clustering algorithm should then be repeated with other tests. If the solution is repeatedly found, it is likely to have the weakest possible sum of the intra-cluster distances. We can assume that the cluster k-means procedure then came up with the overall solution of optimal clustering.

### Distance Measurements: Euclidean Distance

A lately added function of distance is the Euclidean distance, which is defined as:

$$d(i, j) = \sqrt{(|x_{i1} - x_{j1}|^2 + |x_{i2} - x_{j2}|^2 + \dots + |x_{ip} - x_{jp}|^2)}$$

The Euclidean distance takes the difference between two levels directly the expression of the genes. It should therefore be used only for expression data that are standardized appropriately. In short, we include only the terms for which both  $x_i$  and  $x_j$  are present, and divide by p sequence.

Unlike distance measurements as a function of correlation, the Euclidean distance increases in the magnitude of changes in the expression levels of the genes in account.

### Application of the algorithm

The k-means algorithm is in 4 stages:

1. Choose K objects forming clusters
2. (Re) assign each object O to the cluster center The  $M_i$  as  $\text{dist}(O, M_i)$  is minimal
3. Recalculate  $M_i$  of each cluster( barycentre )
4. Go to step 2 if we just made an assignment.

In our case, we decided to stop the groups of cluster in 10 groups and to make 1000 iterations so that the unit stays stable. We can thus define 10 clusters with each one an element in particular provincial direction which is defined by DR.(Moy(Pv\_enr), Taux\_pv\_trans, Taux\_pv\_jugés), which will be also the barycenter of the cluster.



## Displaying results

After execution of the algorithm, the formation of the clusters was made as follows:

**Table 2:** Group representation after 1000 iterations using the algorithm K-means.

Direction provinciale	GROUP
Khémisset, Benslimane, Azilal, Ouazzane, Agadir	0
<b>El Jadida, Taza, Tiznit, Tinghir, Es-Smara</b>	1
<b>Kénitra, Safi, Al Hoceima, Guercif, Taroudant, Marrakech, Es-Saouira</b>	2
<b>Settat, Chefchaouen, Tétouan, Tanger, Sefrou, Fes, Zagora</b>	3
<b>Taurirt, Berkane, Béni Mellal, Larache, Laayoun, Assa Zag</b>	4
<b>Ifrane, Errachidia, Chtouka Aït Baha, Ouarzazate, Tan tan, El Kalâa</b>	5
<b>Meknes El hajeb, Midelt, Oujda, Tata</b>	6
<b>Nador, Drriouech, Khouribga, Casablanca, Sidi Ifni, Guelmim</b>	7
<b>Figuig, Sidi slimane, Rabat, Taounate, Chichaoua</b>	8
<b>Khénifra, Jerada, Boulemane, Dakhla, Boujdour</b>	9

## Expected impacts on steering the HCEFC

Each groups or clusters  $C_i$  include  $n$  number of provincial offices so:  $n = \text{card}(C_i)$  is fairly homogeneous between 3 and 6.

Indeed, by analyzing the results we can notice that according to the cluster where regional Directorate is located, there are efforts to be made at the level of agents or the legal executives/officers of the directorate to improve both the transmission and the follow-up of the tribunals verdicts.

## CONCLUSION

To install this application, we went through three major phases. The first concerns the theoretical part that needs to have a model that can respond to the context of our environment known by its complexity (different actors, rich data, non-homogeneous data, ...). This required a simple mathematical modeling which defines the relationships between the actors, their activities and their needs. The second phase relates to gathering of data and designing a multidimensional database. The third phase is devoted to the implementation and construction of a dashboard checking all the proposals made in the theoretical part.

The availability of real data of the other stakeholders would be enough to have a comprehensive Decision Support Tool for HCEFC.

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