A Decision Support System for Village Economy Development Planning

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ABSTRACT

A number of Decision Support Systems has been designed & developed successfully in many areas like medical, business agriculture, production, marketing and etc. Firstly, I will propose a general methodology for designing a DSS. Data mining techniques may be applied to large data warehouses (DWH) to draw useful information or results, which may be used to improve decision making process. Secondly, I have proposed a Decision support system for Village Economy Development Planning (VEDP-DSS) which may be used by District development planning officer (DDPO), Block development officer (BDO) & Village Surpanch for decision making at appropriate level. The decision regarding village's developments may be further improved using VEDP-DSS. The performance of purposed system is compared with current systems to come out at a conclusion that, decision making can be improved & made more effective with the help of computer based Decision support systems. Moreover, Decision-making may be made more effective, efficient & systematic by using Decision support system. In Future, VEDP-DSS may be further improved by considering other decision factors like quality of the facilities, demographic factors, relative importance of the facilities etc. Some other DSSs for e-governance like population control, pension planning, pay revision planning and etc. may also be designed and developed.

Keywords: Data mining, data warehouse, decision support, datawarehouse, development Index, decision factors, decision tree, Classification.

1. Introduction

In order to limit the scope of this review, a working definition of a decision support system is needed. L. Adelman has defined decision support systems (DSSs) as ``interactive computer programs that utilize analytical methods, such as decision analysis, optimization algorithms, program scheduling routines, and so on, for developing models to help decision makers formulate alternatives, analyze their impacts, and interpret and select appropriate options for implementation" (*Adelman* [1992], p. 2). Another definition has been offered by S. J. Andriole, who *defined decision support as consisting of ``any and all data, information, expertise or activities that contribute to option selection"* (Andriole, 1989). A common idea explicit in each of these definitions is that DSSs integrate various technologies and aid in option selection. Implicit in each definition is that these are options for solving relatively large, unstructured problems. Thus, the following working definition of a DSS will be used in this review: A DSS is an integrated, interactive

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computer system, consisting of analytical tools and information management capabilities, designed to aid decision makers in solving relatively large, unstructured problems.

We see widespread and explosive use of database technology to manage large volumes of business data. The use of database systems in supporting applications that employ query based report generation continues to be the main traditional use of this technology (Chid Apte) .

However, the size and volume of data being managed raises new and interesting issues. Can we utilize methods wherein the data can help businesses achieve competitive advantage, can the data be used to model underlying business processes, and can we gain insights from the data to help improve business processes? These are the goals of Business Intelligence (BI) systems, and Data Mining is the set of embeddable (in BI systems) analytic methods that provide the capabilities to explore, summarize, and model the data. Before applying these methods to data, the data has to be typically organized into history repositories, known as data warehouses. Data warehousing may require integration of multiple sources of data, which may involve dealing with multiple formats, multiple database systems, and distributed databases, cleaning the data, and creating unified logical view of the underlying non-homogeneous data (Chid Apte)

2. Related Work and Background

Information Systems researchers and technologists have built and investigated Decision Support Systems (DSS) for approximately 40 years (Druzdzel and Flynn) . The developments in DSS began with *building model-driven DSS* in the late *1960s, theory developments* in the 1970s, and the implementation of financial planning systems, spreadsheet DSS and Group DSS in the early and mid 80s. Data warehouses, Executive Information Systems, OLAP and Business Intelligence evolved in the late 1980s and early 1990s. Finally, the knowledge-driven DSS and the Web-based DSS were implemented in the mid-1990s. A numbers of decision Support Systems have been successfully designed and developed in areas like business, marketing, finance, Agricultures etc. Decision support systems for e-governance may be also developed.

3. Proposed Work

The existing system followed by State Governments for decision-making regarding village developments, involves analysis of enormous amount of information recorded on papers. The development of region depends upon presence of facilities in that region. The decision regarding future developments of a region depends upon the presence of number and qualities of facilities available currently. For Example, if a village has hundred basic and modern facilities, district comprises of five hundred such villages and further a state comprises of twenty five such districts. Then total entries to be made in records will be 25×500×100= 12, 50000(approx.). Manual analysis of this information is very time consuming and inefficient to take decision regarding further developments.

Problems in existing System

- **Improper utilization of information:** Governments deals with enormous amount of data regarding villages. Most of this information is maintained on paper files. Such information can be utilized for useful purposes, like to help strategic planners in taking decision. A large datawarehouse may be build, on which various analytical techniques may be applied to get useful results. These results then may be used to help decision makers.
- **Slower analysis of Information**: As discussed earlier, most of the information regarding villages in current system is maintained on paper files. It is very difficult to analyze such large records quickly to help decision makers. Its take number of days and more manpower to analyze millions of records manually.
- **Lack of transparency in development work:** Existing system also have the problem of

transparency. Most the fund / budget for development is being consumed by anti social persons in the way. The problem of corruption arises when only person sitting at a position has to release the required fund for the development of that particular region. Moreover, the current system lacks the criterion for budget allocation and only the decision of concerned authority is final for development.

- **Non- uniform Developments**: The level of decision-making is less synchronized in the current system. Some grant comes directly from governments (e.g. announcements in public meetings, rallies etc.) to villages while other villages do not have such direct grants. Some of the districts, blocks and villages are more developed while some are still backward. In Haryana there are villages where the problem of basic needs (drinking water, electricity etc.) is still continues even after more than 50 years of independence.
- **Non-interactive representation of results:** As discussed above the analysis of results is very time consuming & inefficient. Even if one analyzes such large databases manually, then results will be represented in words. Non Graphical representations of results will be more difficult to understand.

We will try to eliminate all above problems from existing system, by designing and developing a DSS for e-governance. Now, I am ready to propose a decision support system called as VEDP-DSS in next section.

3.1 Proposed System for Decision Making

Decisions making regarding budget allocation at Districts, Blocks and villages level may be automated, which helps strategic planners in better decision making. We propose such a system for e-governance and let us call it as a ***Decision support system for village economy development planning (VEDP-DSS).*** Development index *(DI)* for each village & town can be calculated. The *DI* of villages then may be analyzed and used for as how much a village is developed and how much funds it needs for further development during a particular plan. DI must be a basis for actual fund allocation for a particular village. Greater the DI, more developed is the village &vice versa. Now we will define development index.

"Development Index is an approximate indicator on a scale (e.g.10) as how much a village is developed"

Development index of a village depends upon availability and Quality of facilities. These facilities here are called Decision factors (DF).
Calculation of DI is a critical and time-consuming process and need analysis of village information, which may be collected afresh or secondary data from District NIC may be taken.

$$\mathbf{DI = \Sigma\, FI_i / N} \qquad i=1, 2, 3\ldots\ldots n$$

FI= Facility index or rating of a facility available in the village or town.
N= total numbers of facilities available in the village.

Points on a scale of 10 may be given to each of these facilities as per the distance from the village. For better understanding let us discuss an example. If a facility falls within the village then all benefits will be available to that village and we can assign full marks to this facility (e.g. ten out of ten). Further if it falls within 1km from the village then it will be lesser beneficial to village.

For Example

Note: taking in to account only one nearest possible facility

$$\mathbf{DI_{Educational}} = 28/5$$
$$= 5.6$$

Table1: Education Facilities

Availability of Educational facilities	within village	within 1km	within 3km	within 5km	points Earned
1.Primary school	10	×	×	×	10
2. High school	×	×	6	×	6
3.Art/science/commerce College	×	×	×	×	0
4.Engg./Medical college	×	×	×	4	4
5.Computer centre	×	8	×	×	8

We can see village for above example, has a rating of 5.6 rating for educational facilities. Based upon this fact Government may take decision as how much more fund is needed for educational facilities in this village.

Various basic & modern facilities in villages may fall in following categories:

- Medical facilities/healthcare (hospitals, dispensaries, medical halls, ambulances etc.)
- Educational facilities(Schools, college, computer centers, coaching centre etc)
- Communication facilities (BSNL exchanges, STD, IST, Telecom towers etc.)
- Electricity facilities(power houses, generators, power plants etc)
- Transportation facilities (Roads, highways, buses, railways, airports etc.)
- Agricultural facilities (water supply, rivers, fertilizers, seeds, grain market etc.)
- Entertainment facilities (parks, cable TV, welfare etc.)
- Shopping malls/bazaars /mandis etc.
- Other facilities (Gas agencies, old age home, youth clubs, women clubs, anganwaries etc.)

Objectives of the proposed System

- To automate the manual system of information analysis that is time consuming & error prone.
- To make the system of budget allocation transparent & efficient
- To help the government & planning officers to take decision on as how much attention an area needs for its development.
- A graphical representation of the outputs using charts, diagrams etc. for better decision taking.
- The data collected during analysis can be used for any other purpose e.g. to know details about villages.

3.2 Data mining for VEDP-DSS

In VEDP-DSS, data mining techniques have been applied on village datawarehouse to draw useful results, which will form the basis for decision-making. Data mining techniques like decision tree & classification have been used in our system.

- **Decision tree (DS):** A decision tree is a predictive model that, as its name implies, can be viewed as a tree. Specifically each branch of the tree is a classification question and the leaves of the tree are partitions of the dataset with their classification. For VEDP-DSS Decision tree will look like as shown in fig.1. At the root of the Decision tree is the State, which comprises of n number districts, each district m number of blocks, further every block have p number villages and each village q number of facilities.

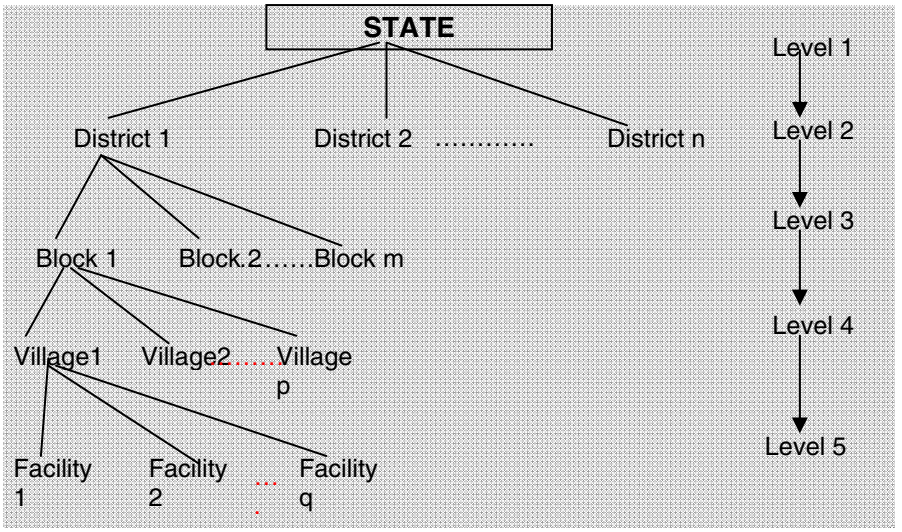

Figure: 1 Decision Tree for VEDP-DSS

Decision tree for VEDP-DSS helps the strategic planners to take decisions regarding developments at appropriate levels. At the root of decision tree state governments may decide as how much fund must me allocated to different districts. At next level, the **DDPOs** of the districts may decide development requirements of the blocks of respective districts. Next at Block level **BDOs** may take decisions regarding village's developments. At lowest level the **sarpanch** of the village will take decision regarding facilities developments in the

- **Classification:** Refers to the data-mining problem of attempting to predict the category of categorical data by building a model based on some predictor variables.

A Classification tree is decision tree that places categorical variables into classes. As in VEDP-DSS we have identified more than hundreds of decision factors, each of which has been placed in distinct classes**.** For example as shown in the fig: 4.3, Basic needs facilities; Education facilities, transportation facilities and etc are different classes for our system.

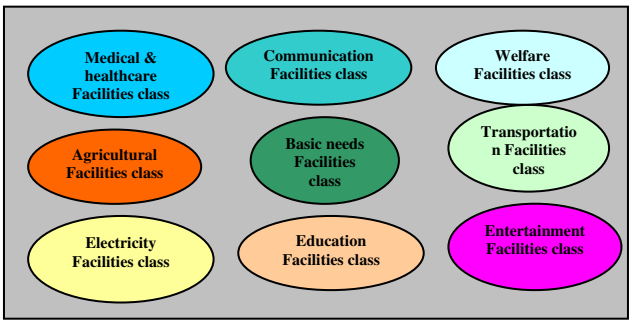

Figure: 2 Different Classes for decision factors

3.3 Algorithms for VEDP-DSS

Two important algorithms for VEDP –DSS have been used. First one is used to calculate the DI of village, block and district at appropriate level. Second Algorithm is used to calculate DI of a particular village,

block and district.

Algorithm 1: To calculate DI of all villages, blocks and districts.
Assume V is the total number of villages in block b, B is the number of blocks in a district d and D is the numbers of district in a state.

Algo: Calculate_Di (V, B, D)

1. For d= 1 to D
2. Begin
3. For b=1 to B
4. Begin
5. For v=1 to V
6. Begin
7. Calvillage_di(v)
8. End
9. Calblock_di(b)
10. End
11. Caldistrict_di(d)
12. End

Algorithm 2: To calculate DI a particular village v, block b and district d.
Algorithm 2.1: Calvillage_di (v)

1. Start
2. Rate all the decision factors of village v on the scale of 10.
3. Take mean of all the ratings
4. return DI of village v
5. End

Algorithm 2.2: Calblock_di (b)

1. Start
2. Find the DI of all the villages that comes under block b.
3. Take mean of the DI of all villages
4. Return DI of block b
5. End

Algorithm 2.1: Caldistrict_di (d)

1. Start
2. Find DI of all the blocks which comes under district d.
3. Take mean of **DI** of all the blocks under district d.
4. Return DI of District d.
5. End

4. Architecture of VEDP-DSS

A DSS have typically three main components namely DBMS, DGMS and MBMS. VEDP-DSS also comprises of three components as shown in fig 3 below

- **Village Datawarehouse:** Villages information is gathered in a store called as village datawarehouse. Data entry operator either at the time of village surveys or secondary data earlier collected may be taken enters such information.

- **Decision Support Dialogue generation:** This component of VEDP-DSS is also called as user interface. This part of system aids decision makers in taking a decision. Three level namely District level, Block level and village level decision Support is provided by VEDP-DSS.

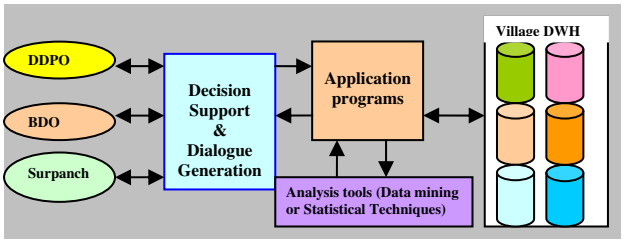

Figure 3: Typical components of VEDP-DSS

- **Analysis Tools**: Component of VEDP-DSS which works on the information stored in the village datawarehouse is called as analysis tool. Such tools may be data mining techniques or simply statistical techniques. This tool summarizes the information and gives useful results, which help the decision makers.

5. Concluding Remarks

The performance of **VEDP-DSS** may be further improved by considering few more decision factors like Demographic factor, Quality of facilities, literary rates and etc. In future I will include demographic factors like Population of village, Male/ Female ratio, Numbers of earning hands in village, Population of NRIs and population density for calculation of development index. Further, I will improve measure of development (DI) of a Village by taking into account the quality of facilities, such as Presence of school with teacher to student ratio. Also, the presence of bank with quality of services provided by bank e.g. loan facilities, availability of lockers and ATM etc. Literary rate of a village also accounts for the development of village. More the literary rate of a village number of peoples will have job opportunities. Moreover, number of educated unemployed peoples has to be considered for development of a village. Few other Decision support Systems (DSSs) for e-governance may be developed in near future. I have identified some area in e-governance such as

- Decision support systems for population Control planning.
- Decision support systems for Pension Planning schemes.
- Decision support systems for Pay commission for state governments
- Decision support systems for grain demands and forecasting in future.
- Decision support systems for establishment of Industrial Growth centre.

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The author was born in 1979 at district Rohtak (Haryana). He completed his Master (M.Tech) and bachelor (B.Tech) degrees in Computer Science and Engineering from Kurukshetra University, Kurukshetra in 2008 and 2002 respectively. He has also completed his MBA in IT management from Guru Jambheswar University of science and Technology, Hisar (Haryana). He is currently working as Assistant Professor in the Department of Computer Science and Engineering, Ambala College of Engineering and Applied Research, Ambala. He has presented more than five research papers in national and international conferences. He has also authored books on Automata Theory and Database Management System. His area of interest includes Electronic-governance, Decision Support Systems, Automata Theory, Database Systems, Computer Graphics and Multimedia.