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A System Approach to Big Data-Driven Smart Municipality Response Model

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Abstract: With the development of computer technology, data and database structure and information systems have become widespread. For a distributed and dynamic environment, it is essential to realize the requirements of daily life in a short time. This study proposes the response model of the municipal system based on big data. It enables how significant sources of information, especially those containing uncertain and incomplete data, are evaluated and analyzed for fast and efficient decision-making with a cloud computing-based reference model. In this study, all data types in the municipal activities environment are assessed and analyzed in the reference model, including data management with sub-modules.

1. Introduction

The main difference between the concepts of smart municipality and e-municipality is that while module definitions are made in the e-state structure, in competent municipality, the necessary updates can be made automatically by evaluating the changing situation and conditions. The concept of smart municipality presented in this study is to evaluate the big data situation and to use the options in the e-municipality portal together with the cloud computing structure and to support it with more dynamic and smart algorithms in the cloud computing environment. It is essential for dispersed and dynamic environments to carry out the operations necessary in daily life in a short time and effectively. The study aims to process, evaluate and analyze large information sources containing uncertain and incomplete data together with the cloud cognitive structure in DSS. With the widespread use of the e-government concept and the program module in Turkey, progress has been made in the application of e-municipality. The proposed cloud computing-based structure can enable the application to reach a wider area with a more flexible and valuable facility. With the reference model developed, the DSS strengthened, and speed and efficiency in business processes increased. Some examples of services in the municipality are; marriage procedures, funeral, and

burial procedures opening a business, building permits, water and sewage operations, natural gas connection and related transactions, property tax, occupancy report, like a garbage tax—local governments in Turkey www.yerelnet.org.tr [1]. A general arrangement can be made from the address. Since the proposed DSS is flexible and intelligent, it can be easily adapted to the relevant data structures and provides the applicable rules to be obtained. Independent decision-making processes can be used to solve dynamic and significant system problems. This study tries to establish a factor-based decision support structure and cluster-based algorithms that consider the municipal information structure, event type and process, time dimension, and system dynamics in a natural environment. At the same time, some examples of application structures are given in the application section.

The remainder of the article is structured as follows: first, some concepts related to cloud computing and municipal management system are reviewed. Next, the proposed cloud computing-based municipal management system is shown. Then the recommended reference model steps are given. Next, the application shows the detail of the user information. Finally, the discussion and some conclusions are discussed.

2. Big Data Driven Model

Cloud Computing (Co-location Independent Online Utility Provided On-Demand Computing) provides the ability to deliver computing services demanded on the internet to desktop computers, laptops, and mobile devices. In short, it provides services such as processing power and storage between provider applications over the web by bidding from a remote location [2-4]. At the same time, the availability of Industry 4.0 and Big Data has made it essential for the development of cloud computing technology [5,6]. The core elements of cloud computing are self-service on-demand, broad network access; shared resource pool; quickness and flexibility; measurable service [7]. Positioning models can be expressed as private cloud, community cloud, public cloud, and hybrid cloud (in Figure 1).

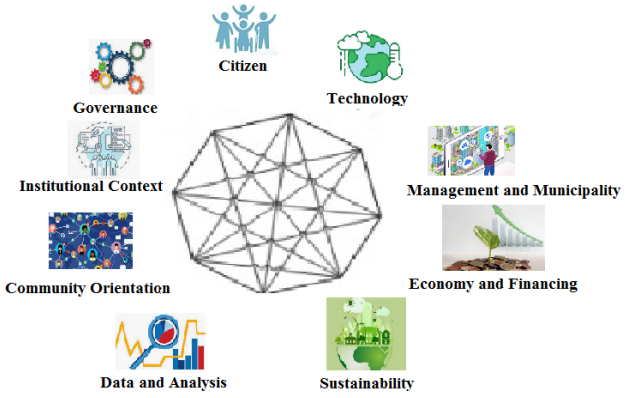

Figure 1: Smart municipality dimensions [8]

Accepting that the data provided through information and communication technologies are independent and objective carries certain risks, as it means ignoring not only the limitations of technical expertise in making sense of the data but also the possible effects of the people involved in the processes of transmitting, processing and analyzing the data. The existence of restrictions on access and other transactions, whose data are determined by regulatory and supervisory units, also shows limitations regarding an order based on information and communication technologies [9,10]. The smart city, which indicates the management of the city through information systems, shows technocratic urban governance. In this sense, it runs the risk of preferring a “technocratic, managerial and entrepreneurial” state to a “citizen-state” at the expense of segments that lack

negotiation skills [11]. It should be noted that instrumental reason and technological solutions will not be enough to overcome deep-rooted structural problems. Different spaces and communities need to be supported with complementary efforts in the social, cultural, and economic fields following the differing characteristics [12, 13].

Cloud Municipality management system consists of three basic structures: cloud-based structure, management structure, and administrative structure. The middleware structure and reliable web service structure included in the proposed cloud computing architecture can be established between the client and the server in the internet environment. In short, it can perform a communication and networking task. The Municipality Information System is aimed the municipality employees receive service in the fastest and easiest way. Implementation will be provided by the cluster-based cloud cognitive interface to be developed. While these processes are being carried out, the developed cloud cognitive-based modules will transfer customer services, observations, and requirements to automation. The municipality management system ensures the information which is received and needs that are followed with the modules. At the same time, the system provides integration with all devices in the institution and organization, ensuring that data is received very quickly and accurately, minimizing the application, waiting, and result in a time of individuals who will receive service to increase corporate satisfaction and to get instant information [14, 15].

The resource layer includes three key functions:

(1) Identify the components and resources of the municipal management system,

(2) Virtualization and

(3) Real-time monitoring status. The measurement of system performance and the standardization process of services determined by user satisfaction will be considered performance parameters.

(1) Cloud-based database - The system uses VMware virtualization and cloud to create a cloud server. In the cloud cognitive architecture to be developed, the municipality management system data is taken and analyzed, and used with an overall usage network structure.

(2) Web-based user interface - Acts as an interface to receive citizen information and establish a connection between the municipal service modules. They can achieve their results more easily through collaborative recommendations and a recommendation system based on relevant indicators. The study will also include personalized citizen information and have the necessary infrastructure for expert knowledge to make recommendations. Users are expected to provide information services under different conditions. The collaborative recommendation system will use the cluster-based algorithm by evaluating users' information (in Figure 2).

(3) Citizen Class. Expresses service demand expectations and post-service evaluations take citizen information and capture citizen relations by Status Class and allocates relations intelligently and appropriately through Service Class. In addition, the Evaluation Class records proposals for design concepts.

(4) Citizen Management Class indicates service providers that provide services. Management System is undertaken by system administrators, analysts, system re-coding, design, and conceptual structure of the system.

Detailed service information of the Transportation Department, which is among the basic divisions of the municipality;

Transportation Information:

•City transportation guide (non-interactive, only providing static route information)

•Timetable and timetables (sea bus, bus, rail systems, cable car, ferry, etc.)

•Announcement of routes that will be closed due to traffic situation, road and maintenance works, maintenance or celebration [16].

Integration and data sharing are the transfer and sharing of information, with connections

established when deemed necessary, between the units of a particular municipality and between municipalities, and between the municipality and other public institutions [17]. In this way, it ensures an information which is created in a certain unit and transferred to the computer environment that can be seen and used by other units without re-entering it. In addition, information networks can be established between public units [18, 19]. Supporting decision-making mechanisms with information and communication technologies is possible to create numerical and graphic screenshots and/or reports that the administrators in the municipality need during decision-making. In this way, managers can make more accurate decisions by looking at all the statistical data on that subject before deciding on any subject [20].

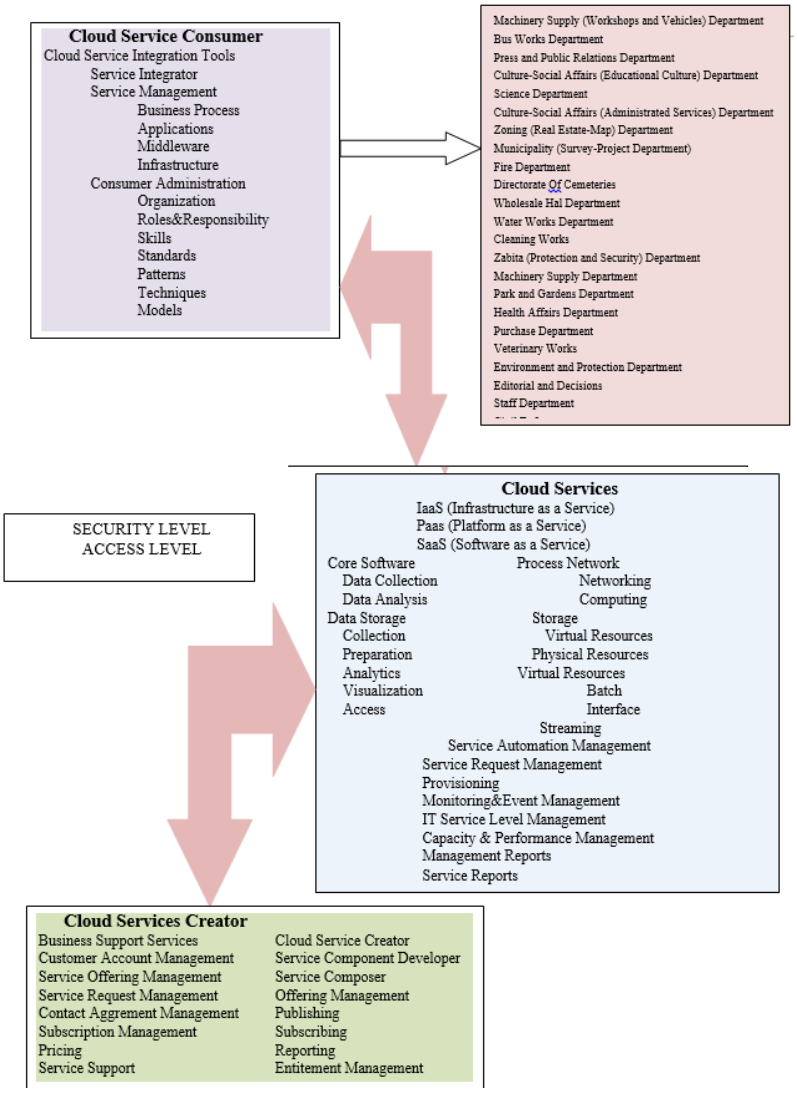

Figure 2: Cloud Computing Reference Model

With the City Information System, the following is possible:

- Preparing the most up-to-date digital and orthophoto maps of the city
- Processing cadastral and property information on these maps
- Processing tax information and declarations on maps
- Transferring infrastructure information to the system
- Preventing losses due to tax and zoning evasion, and increasing incomes
- Keeping urban development under control and directing it as desired; preventing squatting
- Observing the population density, distribution and increase with demographic analysis and

shaping the investments accordingly

• All spatial data can be selected and interrogated according to graphical criteria. With the transfer of the City Information System to the web environment, the application that covers the questioning and numerical display of the administrative address, property, cultural and touristic elements of the entire city is called the City Guide. The aim here is to share the possibilities of associating with the map provided by the City Information System with the citizens on the web, rather than strengthening the municipality's decision support processes. With the City Guide, it is possible to

• Inquiry Address (neighbourhood, street, street)

• Inquire about hotels, schools, historical places, hospitals, pharmacies, and important places in many categories and see on the map

• Access opportunities from one place to another and the shortest distance

• Seeing the important urban elements collectively (for example, the total number of hospitals or schools in the municipality)

A wide variety of technologies can be used in the path of e-Municipalisation. One of the important characteristics of information and communication technologies is that they are constantly developing. For this reason, municipalities should take long-term decisions by thinking ahead in their technology-related choices. This report will focus on some of the most preferred technologies in local governments in the world and Turkey so far. Of course, this list does not cover all technologies. The aim here is to give a general idea about the alternatives that exist. When choosing between these technologies, municipalities should choose the most appropriate solutions for their resources, needs, local problems, and municipal objectives [21].

3. Smart Municipality Response Model

The reference model of the initial stage of the operation system is discussed. The model introduced with a combination of automation system and data-based methods in its structure. Within the scope of the reference model discussed, the processes of the zoning works are listed below. These are, briefly, to produce implementation zoning plans in places where there is no zoning plan, to make plan changes in areas where there are problems with zoning plans; To arrange the zoning status for the parcels in accordance with the zoning plans; To arrange the construction direction survey for the parcels in accordance with the zoning status, to give levels; Approving architectural and static projects for parcels; Issuing construction permits (building permits) for the buildings to be built on the parcels, ensuring that the buildings are built in accordance with the license, taking legal action against illegal constructions; Ensuring the data entry of the zoning during the transition to KBS and updating it afterwards; To determine urban development and growth targets and strategies, taking into account the characteristics of the city and the ongoing urbanization phenomenon; To provide the current use of urban lands, to determine their future use and to mark this on maps; To improve the production conditions of urban housing plots by making housing projections at the city scale; To take regulatory and developmental measures in areas subject to dense human settlements, contrary to plans and rules regarding construction and urbanization; Iskan (Giving permission to use a building); Studies on the durability of buildings against earthquakes; To prepare and implement static reports for dangerous buildings; To give installation project approval; To issue an installation control report for the building occupancy permit; Neighbourhood, street, street definitions and boundaries; monitoring of the old neighbourhood, street, streets; Adding and changing a house number; Adding and modifying independent partitions; Monitoring sealed structures; Fee calculation; Monitoring the latest status of all processes related to a building within the integrated structure and accessing this information

through a single application server. Incoming and outgoing documents Correspondence between units within the municipality and municipality and municipality ensures the recording, monitoring, and archiving of correspondence between external organizations; Each document produced in the units can be tracked with one/several parameters such as its number, date, and the authority it came from, and it can be understood in which authority and by whom the documents are; Documents, petitions, duties, complaints, and messages can be viewed in chronological order within an integrated structure. Documents can be divided into generated, inbound and outbound groups; If the newly produced document is based on an old document, there is a relation number connection; based on the reference number, the services that the document circulates, and the transactions performed on the document can be tracked.

The performance of the system will be evaluated by considering the mathematical model of the cloud cognitive architecture. At the same time, the information in the system will be grouped, and a recommendation system will be created by considering the exact or uncertain data with the rough set-based algorithm below. In the software to be developed, the following algorithm will be used in the SaaS layer of cloud computing. Based on the effective use of big data structures, it is aimed to evaluate and analyze data in fast data traffic, even in a dynamic structure. Rough sets involve the process of organizing incomplete, independent, and uncertain information and performing appropriate data analysis.

Model Analysis

The algorithm is then challenged within the cloud machine that is not used to implement the algorithms within the clouds, data centers, and metering unit brochures. Considering the mathematical model developed by [22, 23]:

Indexes:

j Task (j = 1,…, J)
i Subtask (i = 1,…, I)
p Virtual Machine Type (p = 1,…, P)
k Server (k =1,…, K)
M Large positive integer number

Variables:

T_{ijp} Process time where the task j is performed on cloud-machine p
A_{ijp} 1 if the cloud-machine p-type i is required for sub-task i in task j;
0, otherwise
L_p QoS standard provided by p type cloud-machine (Quality of Service)
C_k QoS standard provided by k server
DS_j Position of the requested j task in the Service Level Agreement
A_p Cost of VM creation
B_t t task transfer unit cost
$\alpha,\beta,\gamma,\delta$ Defined user properties

Decision Variables:

X_{ijpk} 1 if the sub-task i of task j to the server k has been performed on a machine of type p;
0, otherwise
N_{pk} the number of machines of type k assigned to server k;
Y_{ijk} 1 if sub-task i for task j on server k is assigned;
0, otherwise,
H_k Number of tasks assigned to server k
V_k 1 if server k is active, H k > 0;
0, otherwise
Y_j 1 if the j request is not met;

0, otherwise

D_j The amount of task j provided by the server provider

S_j 1 if task j cannot be performed

0 otherwise,

$$F = \alpha \sum_i^I \sum_j^J \sum_p^P \sum_k^K D_j B_i [Y_{ijk}(1 - Y_{i+1,j,k})] + \beta \sum_k^K P_k V_k + \gamma \sum_p^P \sum_k^K N_{pk} A_p + \delta \sum (DS_j - D_j). \quad (1)$$

$$X_{ijpk} = a_{ijp}.\ Y_{ijk} \quad \forall i,j,p,k \quad (2)$$

$$X_{ijpk} \leq N_{pk} \quad \forall i,j,p,k \quad (3)$$

$$\sum_p^P \sum_k^K X_{ijpk} \quad \forall i,j,p,k \quad (4)$$

$$\sum_i^I \sum_j^J D_j t_{ijp} X_{ijpk} \leq L_p \quad \forall p,k \quad (5)$$

$$\sum_p^P L_p N_{pk} \leq C \quad \forall p,k \quad (6)$$

$$M(S_j\text{-}1) < DS_j - D_j \quad \forall j \quad (7)$$

$$M \times S_j \geq DS_j - D_j \quad \forall j \quad (8)$$

$$\sum_i^I \sum_j^J Y_{ijk} = H_k \quad \forall i, j, k \quad (9)$$

$$M(V_k\text{-}1) \leq H_k\text{-}1 \quad \forall k \quad (10)$$

$$M \times V_k > H_k\text{-}1 \quad \forall k \quad (11)$$

$$X_{ijpk},\ Y_{ijk},\ V_k,\ Y_j,\ N_{pk} \in \{0,1\} \quad \forall i,j,p,k \quad (12)$$

$$D_j,\ N_{pk} : \text{integer} \quad \forall i,j,k \quad (13)$$

The objective function consists of four components. The first component expresses the transfer function (Y_{ijk} = 1 and Y_{i+1jk} = 0) in case of sequential subtasks from different servers. Second, the fourth component represents the cost of the servers, the creation of the VM, and the total penalty cost. (DS_j-Dj≥0) refers to the unmet demand. Constraint (2) shows the relationship between the variables X_{ijk} and Y_{ijk}, that is, from task i to task j, from VM to server k (X_{ijk} = 1) if (Y_{ijk} = 1) and (a_{ijk} = 1). Constraint (3) and Constraint (4) show each subtask assigned to a virtual machine from a server if the requested virtual machines are available. Constraint (5) and Restriction (6) refer to the condition that virtual machines and servers do not exceed capacity. In Constraints (7) and Constraints (8), S_j = 1 means missing data status, and S_j = 0 means missing data status. Constraint (9), Constraint (10), and Constraint (11) show the usage status of virtual machines on servers. (V_k = 1) indicates that it is used, (V_k = 0) it is not used. H_k > 0 indicates that at least one task is assigned to the server. Constraint (12) and Constraint (13) represent two non-negative integer variables.

Approximately 135,000 documents, information, and documents were scanned and transferred to the computer environment by Sapanca Municipality and uploaded to the "Digital Archive" database. Buildings in the district (with cadastral data), street-streets, parks, traffic signs, billboards, urban furniture, information about the people living in Sapanca, all information on behalf of the city, together with high-resolution satellite photos, were processed on the map. Ready-made maps, Cadastral Maps, and Zoning Plans of our Sapanca were brought to mind and matched with the knowledge of the Sapanca people. The "Smart City Automation Information System" by Sapanca Municipality to create an infrastructure for the "e-government" application, which offers modern solutions to the communication of municipalities and the public, to create earthquake risk maps, and to help plan the measures to be taken against possible natural disasters quickly and effectively. It was completed and put into practice in 2011. In the system, all data (Space, Time, and Attribute)

can be defined, stored, processed, and analyzed in a single database in an efficient and detailed manner. In this way, time and money can be saved in decision-making and implementation processes, and an enterprise resource planning infrastructure can be created. In the e-Government process, AKOS established an integrated automation information system based on laws, regulations, and standards. With a cloud computing-based reference model to this system, the system will work more flexibly, quickly, and securely. Works and transactions in all units of the municipality can be done through AKOS application software. As a result of the job done with AKOS applications, all information in the system is updated, and the continuity of the system is ensured with new data entry and updating of existing data.

It consists of GIS (Geographic Information System), MIS (Management Information System), Internet-Mobile Applications, and Citizen-Oriented Interactive Applications. The number of communication channels is increased with systems such as E-Municipality, City Guide, Kiosk, Mobile Municipality, Electronic signature, so that citizens can reach the Municipality and receive services from any platform independently of time and place. To bring Participatory Municipality to the fore and provide faster and higher quality service to the citizens, citizen satisfaction and personnel productivity are increased by providing assistance with the Alo 153 Communication Center and White Desk service units. With AKOS, all information systems of the Municipality were gathered under a single roof, and all kinds of verbal and spatial information were made available through a single relational database. The information infrastructure required for all operational and administrative activities was created. Establishing the AKOS Municipality Management and Geographic Information System in a working state in a single database, ensuring an integrative information integrity by using these two systems together (Information System Automation), transferring the relations between the municipality and the citizens to the electronic environment, giving it a modern and dynamic structure (e-municipality), on the one hand, with spatial analysis and inquiries; revealing and constantly updating the social, economic and cultural texture and needs of the city, on the other hand; By raising the income sources to the highest point, besides the classical municipal practices of the municipalities, the city; ensuring that they meet all their social, economic and cultural needs (Socio-Economic Texture Analysis, Income Increasing Studies); Ensuring the working environment and infrastructure in full coordination with other public institutions and organizations that directly or indirectly affect the city life (Inter-Agency Coordination).

However, the following operations were carried out by the zoning unit:

Nearly 350 building drawings, photos, and building information updates,

Realization and drawing of approximately 700 parcel movements (unification, subdivision, change of type, creation, abandonment, etc.) (The company has delivered 1340 parcel movements, but the number is now 2000).

Detailed information of 46 parks across Sapanca (parcel, address, playsets, photos, ground-lighting-irrigation information, etc., all other information and photos were put into the system. The company did not put the parks in the system (in Figure 3).

Correction or updating of the address information (door number, interior door number), building information (door number and interior door number) of the citizens who come to the 420 directorate of Zoning

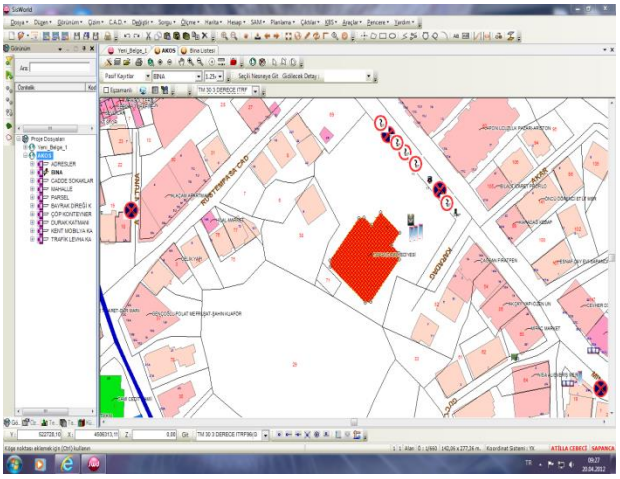

Figure 3: Example of zoning module plan output

TAKBİS data was obtained from the Land Registry Directorate by the protocol and delivered to the collection chief.

Building drawings have been overhauled as much as possible on the map. Because Zoning also takes the building area from the building drawing on the map.

Street-street updates, especially parquet and paved streets, drawings of newly opened ones, and information entry have been put into the system as much as possible.

Contact information has been collected from 4,340 independent sections in the system, and the total number of contact information is around 16,500. Considering that the official population rate is around 32 thousand, half of the citizens officially living in Sapanca town has been collected. Many of our citizens did not specifically provide information or could not be found at home. Although most of them were on the estates since they were summer residents, they could not be found at home because the project fieldwork was done in winter. Updates will continue to be made as citizens come to our municipality (in Figure 4).

Access to the Municipality

Citizens can apply to the Municipality in person or reach the Municipality outside working hours through fax, telephone, e-mail, internet, and SMS [24, 25].

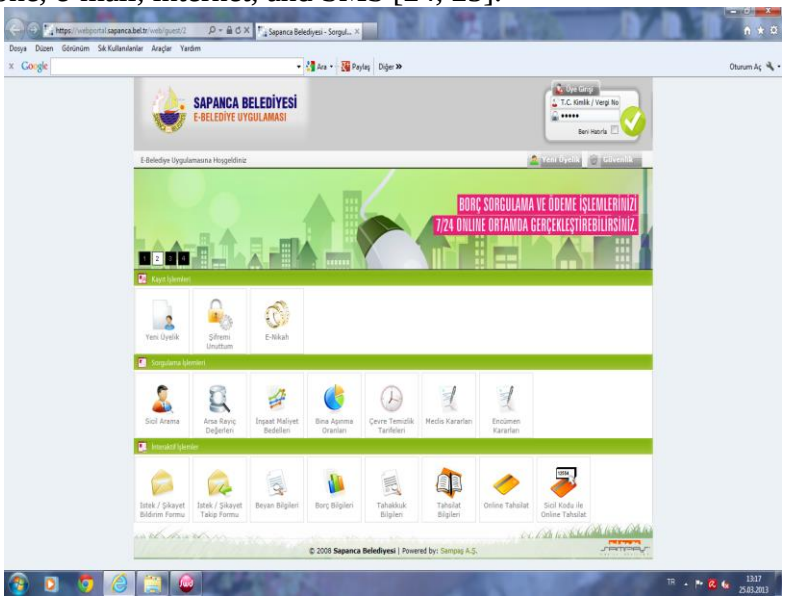

Figure 4: Sapanca Municipality – e-municipality application example

Routing and Tracking

Applications are automatically forwarded to the relevant persons by the preferred methods (e-mail, sms, etc.) according to their subject. Municipality employees can follow up these complaints on the computer, and automatically forward them to other units related to the complaint, accompanied by e-mail, when necessary.

Analysis and Evaluation

Incoming requests and complaints are detected in the smart address system with map support. The information about the citizens and their relatives is evaluated through the data gathered from various sources. It is analyzed whether they are suitable for the aid and social activities provided by the municipality.

Decision Support

The collection of complaints and suggestions in a single-center is an essential factor in determining the faulty aspects in the services of the municipal top management and making long-term plans. Incoming complaints and suggestions show which issues there are deficiencies and which services can be provided better (in Figure 5).

Automatic Notification

When the complaints received by the system are resolved, the relevant actions are written on the complaint tracking form on the computer, an SMS message, fax or e-mail is sent to the person concerned, and the information that the complaint has been closed is sent along with the application form number.

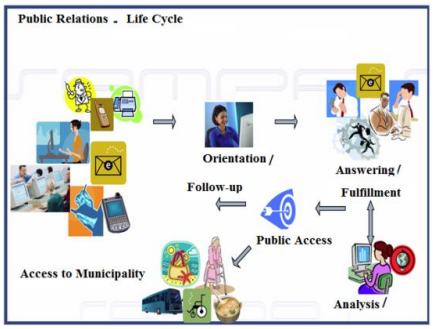

Figure 5: Municipality - Citizen Service Management

Public Access

The system ensures that assistance and activities reach the right people with less labour and time loss. In addition to the Automatic Notification function, Citizens can also inquire about the status of their requests and complaints over the web.

4. Conclusion

The reference-based model developed to help make effective decisions with the most effective rule chain, together with a large volume and incomplete, ambiguous information structure and a decision support structure to be created with a computer software program. It provides the necessary logistic support according to the scenarios created. This study, it is aimed to develop cluster-based algorithms for big data analysis in cloud computing platforms and hospital applications of the developed models. With this proposed model, services are provided quickly, safely, and uninterruptedly. According to the Personal Data Protection Law, the security of citizens' information is ensured. Authorized users will only be able to access data within their authorization. Log records of all transactions are kept. It provides access to municipal services independent of time and place. An infrastructure that can provide uninterrupted and secure service has been established. Service delivery was ensured through citizen-oriented mobile applications. An active

working system is envisaged. When one system stops, the other system is activated immediately. Our Disaster Recovery Center (FKM) is kept on physical servers. It saves resources and time. It provides personnel savings. Reduction of paperwork and bureaucracy is ensured. Standards and transparency are provided in services. Investments are accelerated. Instant reporting of municipal services, activities, works and transactions is provided. It provides the opportunity to manage, provide services and citizens to access services independently of time and place. It is ensured that all transactions of municipalities can be carried out uninterruptedly in the electronic environment.

References

[1] www.yerelnet.org.tr

[2] Kitchin, R. (2014) The real-time city? Big data and smart urbanism, Geo Journal, 79(1), 1-14.

[3] Swyngedouw, E. (1996) Reconstructing citizenship, the re-scaling of the state and the new authoritarianism: Closing the Belgian Mines, Urban Studies, 33(8), 1499-1521.

[4] Datta, A. (2015) New urban utopias of postcolonial India. Entrepreneurial urbanization'in Dholera smart city. Gujarat', Dialogues in Human Geography, 5(1), 3-22.

[5] Noltes, J. 2011. "Data location compliance in cloud computing", Master thesis, Track information system engineering, University of Twente, Netherlands 30-31.

[6] Taylor, C. (2011) Cloud computing at the University level: A study of student use of cloud computing applications, Master .thesis, M.B.A, Appalachian State University, North Carolina, United States, 12-13.

[7] Kok, G. (2010) Cloud computing and confidentiality, Master thesis, Computer science, University Of Twente, Netherlands 12-13

[8] Rittinghouse, J., Ransome, J. (2010) Cloud Computing: Implementation, Management, and Security, 1, Printed in the United States of America CRC Press, 35-36.

[9] Amr S. Abdelfattah, Tamer Abdelkader, EI-Sayed M. EI-Horbaty, (2018) RSAM: An enhanced architecture for achieving web services reliability in mobile cloud computing, Journal of King Saud University - Computer and Information Sciences, Information Sciences Volume 30, Issue 2, Pages 164-174

[10] Christensen, J.H. (2009) Using RESTful web-services and cloud computing to create next generation mobile applications Proc. 24th ACM SIGPLAN Conf. companion Object oriented Program. Syst. Lang. Appl., pp. 627–634

[11] Dillon, Th., Wu, Ch., Chang, E. (2010) Cloud Computing: Issues and Challenges", IEEE International Conference on Advanced Information Networking and Applications, (24), 29-30

[12] Gonsai, A.M., Raval, R.R. (2014) Enhance the Interaction between Mobile Users and Web Services using Cloud Computing, Orient J.Comp. Sci and Technol, 7(3), 1–9

[13] Turgay, S. (2022) Reference Model of Cloud Computing Based Decision Support Hospital Management System, Cloud and Service-Oriented Computing, Clausius Scientific Press, Canada) Vol. 2, DOI: 10.23977/csoc.2022.020101, ISSN 2516-399X Vol. 2, Num. 1

[14] Amr S. Abdelfattah, Tamer Abdelkader, El Sayed M. El Horbaty (2018) Achieving web services reliability in mobile cloud computing", International Journal of Mobile Network Design and Innovation, 8, No.4

[15] Cobarzan, (2010) A., Consuming web services on mobile platforms, Inform. Econ., 14 (3), pp. 98–105.

[16] Sanchati, R., Kulkarni, G. (2011) Cloud Computing in Digital and University Libraries, Global Journal of Computer Science and Technology, (1.0), 2-3.

[17] Parlak, B. and Sobacı, Z. M. (2008). Website Based Services of Metropolitan Municipalities in Turkey: A Comparative Functionality Analysis", (Ed.) Parlak, B., New Visions in Public Administration, in Turhan Publishing House, Ankara (in Turkish).

[18] Wang, S.L., Chen, Y.L., Kuo, A. M.S., Chen H.M., Shiu Y.S. (2016) Design and evaluation of a cloud-based Mobile Information Recommendation system on wireless sensor networks", Computers & Electrical Engineering,: 221-235

[19] Öztemel, E. Applied Total Quality Management in Municipalities, Değişim Publications, 2001, Adapazarı (in Turkish)

[20] Wang, S.L., Chen, Y.L., Kuo, A.M., Chen, H.M, Shiu, Y.S. (2016) Design and evaluation of a cloud-based Mobile Health Information Recommendation system on wireless sensor Networks, Computers & Electrical Engineering, Vol. 49, January, Pg. 221-235. http://doi.org/10.1016/j.compeleceng.2015.07.017

[21] www.bilgitoplumu.gov.tr/edtr.asp

[22] Shahdi-Pashaki, S., Teymourian, E., Kayvanfar, V. (2015) Group technology-based model and cuckoo optimization algorithm for resource allocation in cloud computing, IFAC-Papers On-Line 48-3, 1140–1145, Information Control Problems in Manufacturing May 11-13. Ottawa, Canada.

[23] Skúlason, R. (2011) Architectural operations in cloud computing, Master thesis, School of Engineering and Natural Sciences University of Iceland, Reykjavik, Iceland: 8-9.
[24] Wyld, D. (IBM Center for the Business of Government) 2009. "Moving to the Cloud: An Introduction to Cloud Computing in Government", (IBM), 12-13, 28-29.
[25] https://www.belediye.gov.tr