

# **Applications of Geographic Information System in Fields of Utilities – Greater Cairo Utility Data Center**

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**Key words:**

## **SUMMARY**

Paper about the Greater Cairo Utility Data Center, Cairo Governorate and its experiences in creating applications of GIS in the field of utilities.

# Applications of Geographic Information System in Fields of Utilities – Greater Cairo Utility Data Center

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## 1. INTRODUCTION

### 1.1 Since 1980 up to 1986

- During the period of establishing the underground metro (First phase, Helwan – El Marg). The planning & executive authorities suffered a great deal from the following :
- The unavailability of base map with a suitable scale with old versions print 1938 /1948.
- The unavailability of accurate survey maps for the above and underground utilities (They were sketches unconnected to the survey net.), This also leads to the consumption of time and cost, and damages of utilities.

### 1.2 On the year 1986

Increasing of the losses & damages of utilities estimated by 22 million LE as follows:-

Utility	Elec	Tel	Water	Sewage	Gas
Damage Rate	38%	30%	12%	5%	-

This leads Cairo Governorate to take the decision of established Cairo Utility Data Center in order to stop damage of infrastructure.

## 2. THE TARGET OF ESTABLISHING UDC

- Establishing scientific data base for underground utilities
- Protecting the investment of underground utilities in order to guarantee the continuance of utilities “Services to all citizens”.
- Providing city planners and decisions makers as well as consultants with accurate data of the infrastructure projects.
- Forbidden random digging, assisting contractors, utilities authorities to work without damages of the networks.
- Co-ordination among agencies and utilities in the field constructing underground utilities in the field constructing underground utilities in order to avoid repeating digging and protecting public fund .
- Protecting the environment from pollution resulting from cracking or explosion of water and sewage pipes as well as rapid determine the exact location of damage in order to assist in the process of repairing and maintaining .

The Greater Cairo Utility Data Center has obtained the international quality certificate ISO 9002 year 1999, there UDC has obtained ISO 9001 – year 2003.



### 3. ESTABLISHMENT PROCESS OF UDC

- Greater Cairo Utility Data Center is a unique center in the field of utilities in A.R.E and in the middle East, including Israel and Turkey.
- Cairo Governor Decision No. 330 dated 19 –10 – 1988 to establish UDC
- Co- operation with Finland to establish Cairo utility Data Center by a 4 year Finnish grant from 1988 to 1992 (about 5.5 Million us + 3 Million LE representing a ratio of 23.2 from the total cost.
- UDC has succeeded with in the grant period in training and technology, began to establish Data Base and production, in all utilities projects since 1990 At the same time a new

branch office fully equipped with instruments consists of (5) field team (Survey + Detection) + GIS Dept. using ARC/INFO.

- The success of UDC locally and internationally lead the Finnish side to extend the grant for more another 3 years from 1992 – 1997, about 1.5 million us, and increase field teams to 7 teams.
- Another 6 Branch offices were established to cover Cairo and exceeding the number of teams from 7 teams to 38 teams.

#### 4. THE AFFECTED DATA ON PLANNING AND MANAGEMENT OF UDC WORKS

Utilities network lengths in Cairo Governorate (Km)

م	المرفق	٨٢	٨٧	٩٢	٩٧	٢٠٠٢	٢٠٠٣
١	قطاع المياه	٧١١٥	٨١١٥	٩٦١٥	١١١١٥	١٧٤٠٠	١٥٢٩٨
	مياه شرب	٧٠٠٠	٨٠٠٠	٩٥٠٠	١١٠٠٠	١٧٠٠٠	١٥٠٠٠
	مياه عكرة	١١٥	١١٥	١١٥	١١٥	٤٠٠	٢٩٨
٢	قطاع الصرف الصحي	٣٢٠٠	٣٥٤٠	٣٩٦٠	٤٦١٣,٦	٧٤٦٠,١	٥٨٤٥,٨
	الهيئة العامة للصرف الصحي	٣٢٠٠	٣٥٠٠	٣٩٠٠	٤٥٠٠	٦٦٠٠	٥٤٥٠
	الجهاز التنفيذي للصرف الصحي	—	٤٠	٦٠	١١٣,٦	٨١٣,٤	٣٥٤,٦
	تصريف الامطار	—	—	—	—	٥٠٦,٣٨	٤١,٢
٣	قطاع الكهرباء والطاقة	٢٢١٩٦	٢٦٢٤٧,٥	٣١١٠٦,٥	٣٧٣٥٠,٨	٤٣٣٥٥,٨	٤١٢١٦,٨
	الجهد العالي	٥٣٩	٩٢٨,٥	١٢٦٠,٥	١٨٥٥,٨	٢١٥١,٨	٢١٥١,٨
	الجهد المتوسط والمنخفض	٢١٦٥٧	٢٥٣١٩	٢٩٨٤٦	٣٥٤٩٥	٤١٢٠٤	٣٩٠٦٥
٤	التليفونات	٢٥٤٤٧٥	٣٦٨١٧٨	٤٨١٩٠٠	٧٦٣٧٠٧	١٢٥٢٣٠٠	١٢٥٠٩٠٠
	كوابل الربط	٤٢٥	٤٧٨	٥٥٠	٦٥٧	١٤٠٠	٩٠٠
	شبكات رئيسية وفرعية	٢٥٤٠٥٠	٣٦٧٧٠٠	٤٨١٣٥٠	٧٦٣٠٥٠	١٢٥٠٩٠٠	١٢٥٠٠٠٠
٥	الغاز	٤٧٥,٥	١٤٥٢,٤	١٧٠٣,٢	٢٢٢٩,١	٣٣٨١,٥	٢٨١٥
	تاون جاز (توزيع المدن)	٤٧٥,٥	١٤٥٢,٤	١٧٠٣,٢	٢٢٢٩,١	٣٣٦٦,٥	٢٧٤٨,٥
	نات جاز (السلام والنهضة)	—	—	—	—	—	٤٧
	جاسكو (خطوط رئيسية)	—	—	—	—	٥	١٩,٥
٦	البتروول	٣٣٤	٦٠٧,٦	١٠٤٨,٣	١٠٤٨,٣	١٢٥٦٣	١٠٤٨,٣
٧	مترو الانفاق	—	٤٣	٤٣	٦٢,٥	٧١,٥	٦٢,٥
	فوق الارض	—	٣٨,٨	٣٨,٨	٤٥,٧	٦٢,٥	٤٥,٧
	تحت الارض	—	٤,٢	٤,٢	١٦,٨	٨,٧	١٦,٨
	الإجمالي العام	٢٨٧٧٩٥,٥	٤٠٨١٨٣,٥	٥٢٩٣٣٣	٨٢٠١٣٦,٣	١٣٣٤١٣١,٩	١٣١٥٩٤٧,٤

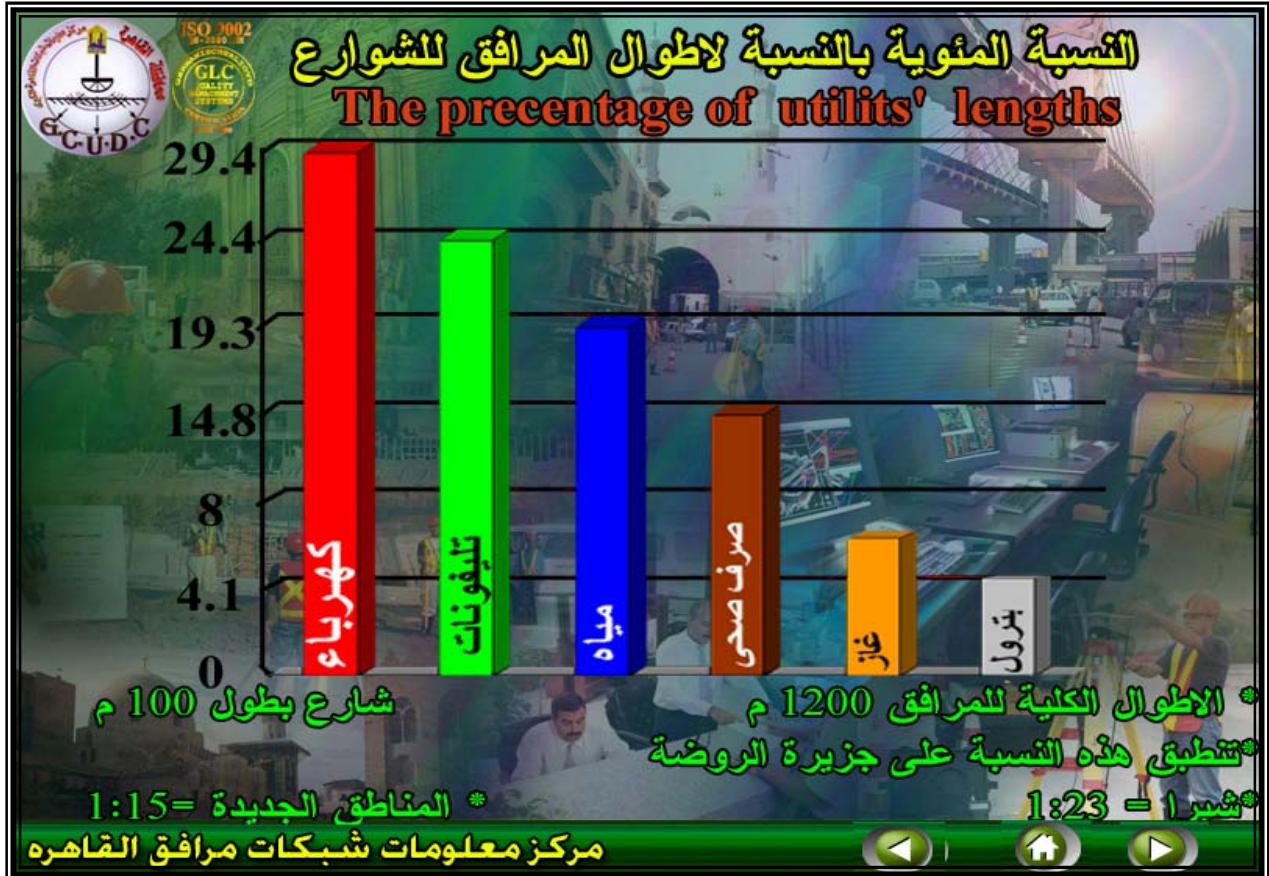
Percentage of utilities' lengths:

- Electricity represent 50% from the utilities
- Telephone represent 29%
- Water & Sewage 7%

- Gas 5: 6%

As well as pipes are found in certain areas.

House connections 25% of the total length of each utility.



## 5. PROCESS OF ESTABLISHING GIS CENTER

### 5.1 Establishing ground control point

- UDC established survey triangulation net. From the 1<sup>st</sup>. degree with the assistance of professors of survey engineering in the Egyptian universities, connected to network of A.R.E and cover all over Cairo.
- As well as establish a benchmark network, in order to take measurement in the direction Z with a high level of accuracy for the sake of a lot of projects especially of sewage and rain drain go. It can be summarized as follows:
- Establishing (89) triangulation point achieved density of 1 point / 7 km<sup>2</sup>

- Establishing (1004) traverse point achieved density of 1 point /7km<sup>2</sup>
- Establishing (177) bench mark to measure leveling and depths from the sea level achieved density of 1 bench marker / 4 km.
- Within the frame of technology, and using global positioning system (GPS).
- UDC has attributed in the survey project of A.R.E airports, and establishing (81) GPS point, adjusted and connected with London - Cyprus – South Africa.

## 5.2 Base maps

UDC started to survey main landmarks above the ground to produce base maps scale of 1:500 to allocate the utilities net, and to make it easy to determine the exact location of the utility. UDC uses the most sophisticated survey equipments and also with the assistance of GPS equipment (NASA – Glonass).

## 5.3 Underground infrastructure

- Detection of underground utilities by using detection equipment's RD, without digging, and determining the location of pipes and cables whatever they are. Water, sewage, electricity as well as its depths.
- Field teams survey such detected utilities and store data on data collectors to be transferred to computers, make editing and produce final maps.
- After editing the data, it is transferred to workstation in the system dept. by using ARC/INFO one of the main GIS programs.
- System Dept. creates data base for the utilities and complete all attribute data, edit and sorting different types of utilities by using code for each.

Finally, producing maps for the client, including printing by geographic science in order to achieve the accuracy required for maps:

- Printing each utility with a unique color , for ex:-
  - Electricity with red
  - Tel with green
  - Sewage with brown
- We also create a code pamphlet delivered to the client as a key code for these codes
- Base map must illustrate all main data and landmarks
- Recording triangulation point on the map and divided into grid equivalent with the scale of the map, the map must include all base data such as north direction, map scale, project title, reference map and updating the map , not only the base map but also utilities data .
- In Cairo there are some tunnels such as sewage tunnels or the underground metro in such cases , we are not only allocate the path of the tunnel or the underground metro but also the surrounded area which are not allowed to do any works in it .
- Map printing with scale (1:500 – 1:250) or sometimes 1:100.

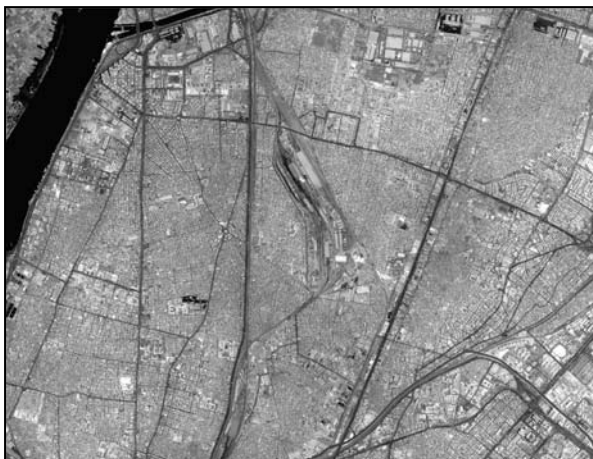
- Delivering to the client a collective map with the exact location of utilities, in order to execute his works without any damages for the other utilities.

#### **5.4 Implementing comprehensive cadastral works for upper structure**

- One of the most important works undertaken by UDC is producing cadastral maps by scale 1:5000 indicating all guideposts in the field area such as schools – hospitals – hotels –clubs – magazines of different activities ..... etc
- UDC started a while ago implementing cadastral works and creating a complete GIS data base for many Cairo districts using 1:500 maps. This data base includes all elaborate data for all activities, signposts, estates and number of levels in them, besides so as to get the scale 1:5000 from the maps. These maps and what so ever data indicated is so rich and it enables decision. Makers to decide whatever decisions that needs accuracy and fastness and in the meantime has a renovated, fast and accurate information.

#### **5.5 Copping the modern technology the Center makes the processing**

Required for bi – dimensional, and very accurate satellite images in order to get use of it in producing digital maps.



#### **5.6 Implementing Networks and Calculating**

The amounts of filling and digging.

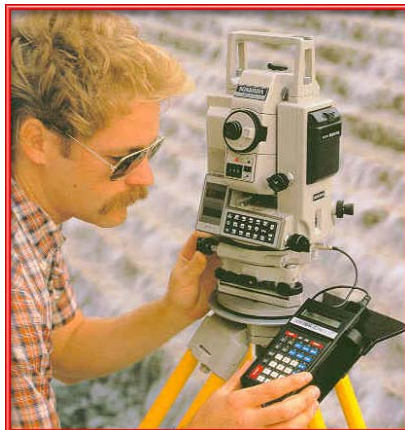
The Center proved its professions and superiority in the field of GIS, computer data mechanism, its accurate data which could be obtained fastly. Cairo governor assigned to the Center undertaking all networks essential for supplying new constructive areas, calculating amounts of filling and digging by means of sowing public money and guarantee man fraudulency of contractors in calculating and estimating such huge works.

## 5.7 In a Recent Stage all Different Data Which Serve other Multiple Usages Were assembled

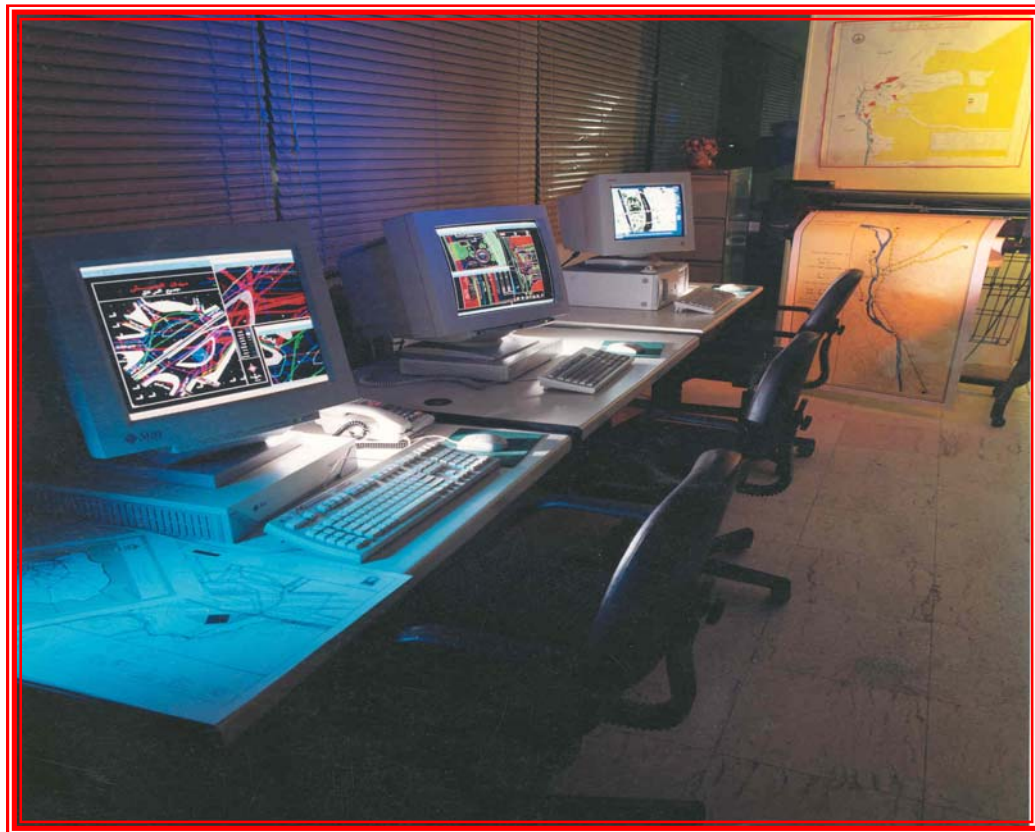
- In recent years Greater Cairo Utility Data Center has become of the most chaneefenized centers which possess a huge human as well as information treasure for different data through which assistance and support could be provided for other districts the center also shares in establishing other data centers in different governorates Scubas Khalubiya Munofiya and Giza.
- The Center also participated in offering training courses in the field of computer and detecting utilities – Tourism Promotion Authority – Soqr El-Obour – Same Districts Like Matariya.

## 6. A BRIEF NOTE ABOUT EQUIPMENTS (DEVICES ) & PROGRAMMES USED

- Electro –magnetic Detection Equipment.
- Total Stations.
- Satellite detection equipments, permanent stations GIS.
- Equipments for GIS such as: PC's – Scanners – Printers – Plotters – Workstations – Digitizer – UPS – Servers.
- Microfilm Equipments.
- Safety means for work field.
- Surveying, GIS, administrative, financial and planning programmes.







## **7. THE TRAINING STAGE**

### **7.1 Training Courses**

- The training courses which were held reached a total number of (288) courses including fieldwork and GIS for a number of trainers estimated by 2154.
- The Courses also Concentrated on qualifying employees to use the most equipped devices and Programmers .

### **7.2 The training in clouded**

- Training (2) engineers of public vocation and Gaza Municipality/ Palestine due to the difficulty in the Palestinian side to obtain utility maps so they were trained for surveying works and GIS programmers.
- Training (2) South Korean engineers due to the visit paid by chief of and inspecting the development in the field of deflecting for utilities in year 2000.

### **7.3 Deming the period 1989 and January 2001 the Center had**

People to be trained how to use the most recent and modern equipments in the field of detecting utilities and surveying programmers in the United States, Britain and Finland.

## **8. THE MOST IMPORTANT PROJECTS OF ACHIEVEMENTS**

In Cairo Governorate:

- The second stage of the underground – appreciation of the French part for the accurate maps.
- Extension stages of 6th October bridge.
- Planning underground garages indicating all utilities underground.
- Planning, implementing and following up stages of both Al – Azhar and Opera tunnels
- Developing all pedestrians and car tunnels in the city.
- The Central Regional Control network of Egypt's Electricity Body (fiber optical ) with a total length of 290 km in Greater Cairo.
- Telephone service cabins in streets and squares (planned (10) thousands from which (4) thousands were implemented.
- Detect basic data and utilities for all establishments of Arab Organization for industry.
- All projects of developing pivots (Autostrad – Gisir El- Sues – Haicstep – Oropa) .
- Random areas and developing them.
- Rain water drainage pivots (Oropa – Haicstep – Gisir El- Sues El-khalifa El-Mammon) in co- operation with the Ministry of Housing.

- All utilities projects (water – sewerage system – electricity – telephones – gas – petrol) which were planned and implemented in Greater Cairo.
- Surveying of a member of 18 airports in the Republic.
- Petrol line project from Mustorud till Haicstep.

All over governorates:

Support, supervise and plan for branches of utility data center in Kalyobiya governorate Shobra El- khema then. Banha city, then Giza, Fayoum, Menofiya and Sharkiya governorates. Besides, another two data centers in Alexandria and Ismailia governorates are under establishment according to instructions of Prime Minister to establish a data center in each governorate.



In Arab Republic of Egypt:

- A public tender was obtained from the civil Aviation Authority to detect (18) airports, (9) navigational support where as (4) Egyptian bodies and a foreigner one were competing with the center to get that tender.
- The center was accepted technically and financially (in which the center’s offer is 3 million L.E less than the nearest technical correspondence body) .
- The project was implemented in 12 months the results were accepted in the International Aviation Token. The Authority submitted a thank you letter to UDC and asked UDC the supervision of all works every 24-months.
- UDC had participated in the First National Conference for GIS during the period 29 – 30 April in 2000.

On the Arab international level:

- UDC was invited to attend international conferences in Qatar, Tunisia and Lebanon.
- UDC had participated in 2 international conferences in the United States of America for GIS for ESRI Company in year 2000 the company had issued in its operative magazine the UDC achievements.
- In year 2000 UDC was offered ISO 9002 certificate from Germany in the field of administration and productive quality for a number of 21 UDC comprehensive process.

- Now UDC deals with different planned , executive and scientific bodies in Greater Cairo as a matter of fact UDC gives monthly secure and confidence for all employees in utility authorities and companies but for citizens for provided service with a special characteristics, saving time and effort , and its accuracy in producing utilities, maintaining developing .

## 9. CONCLUSIONS

- UDC succeeded in achieving its goals.
- The importance of preserving the distinguished scientific wealth resembled in youth who achieved advanced efforts.
- The spreading of technology is a must for all Egyptian governorates to protect infrastructure which is carried out by country, where as no comparison could be made due to establishing a data center with the costs of utilities needed to be preserved. Then the future outlook attained by UDC such as the practical control over country estates in each governorate to provide new survey chances for these centers.
- By establishing UDC in governorates it fulfills for the governors the following.
- The possibility of limiting country estates and any activities over accurate surveying maps.
- Decision making for any plan or establishments by determining the control proportion status for services and places to be developed or establishing projects over recent maps and accurate data.
- Attain a comprehensive mechanism for governorate activities and services by using GIS.

### Attached documents

1. A map indicating Greater Cairo borders and location of all U.D .C's in Cairo and others.
2. A model for UDC utilities separately and another in common.
3. 3D network.
4. A pant of 1:5000 scale map.
5. A pant of a complete cadastral 1:500 map.
6. Imaginary surface for any airport.
7. 1:1000 Cairo Airport.

## CONTACTS

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