Full Length Research Paper

Application of Smart Community Indicators in New Egyptian Communities A Case Study: Smart Village, Greater Cairo, Egypt

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Abstract
World is facing rapid developments in information and communication technology, which formulate new type of cities called smart cities. This kind of cities uses new information and communication technology in all of its economic, social, environmental, institutional components to achieve better performance for cities and make them more competitive in the local and international level. Application the concept of smart city in our cities depend on achievement group of characteristics, factors and indicators to measure the degree of using ICT in different fields of life and order the cities according to this degree. Therefore the paper aims to apply smart communities indicators in one of smart Egyptian community (smart village) to identify existing and non-existing indicators and show the gap between the theoretical indicators and case study characteristics according to comparative analysis. Thence the paper consists of three parts. Part I, clarifies the definition of smart city and the theoretical indicators of smart city, Part II, identify main characteristics of the Smart Village (Economic - social - environmental - institutional ...) and part III refers to the results and recommendations for development an integrated vision for the smart village to be integrated smart community able to compete locally and internationally.

Key words: *Smart city– Smart village– Information and communication technology (ICT)– Smart economy– Smart people – Smart governance – Smart mobility- Smart environment- Smart living.*

Introduction
The concept of smart cities appeared in the world as a result of development in information and communications technology, which formulate new requirements and needs for cities. The early studies such as (Graham study) shows that smart cities depend on the existence of economic activities which use ICT to improve their performance and productivity and achieve its objectives. (Graham and Marvin, 1996).

Caragliu added new features of smart city such as using technological services, developing transportation system, investment of human capital, wise management of natural resources and existence of an institutional structure within the city. These features aim to achieve better level of services for population and investors, support sustainable economic development, find a good quality of life and make smart cities more sustainable through participation of people and governance because not all cities which use ICT in economy and services are smart cities. (Caragliu et al; 2009).

The European union (EU) uses the term of smart city as a place includes citizens and activities with the aim of improving quality of life by (finding integrated solutions with new innovations - better planning with more participatory methodology – efficient use of energy, water and transportation - using ICT in all aspects of Life) (Paskaleva, 2009), According to previous concepts, It can be concludes that smart city is sustainable city which uses ICT in all its compounds with the aim of achieving better quality of life for cities through incorporation of information and communication technology in all dimensions (economic - social - environmental – infrastructure – institutional).

During the few recent years, many countries interest to evaluate some cities especially European cities according to smart city indicators to identify their strengths and weaknesses and try to make these cities more competitive by putting set of plans for them (Caragliu et al; 2009; Giffinger ,2007) ,In the Egyptian case, there is trend to create some communities and economic activities centers which use ICT and have significance at the local and global level such as smart village in new cities., But these communities need some revision and evaluation to determine their important pros and cons and put the requirement for application an integrated smart community concept.

Therefore this paper aims to implement smart community indicators in one of targeted smart communities which was built firstly (smart village in greater Cairo) for identifying its arrangement according to these indicators and determination required indicators to make it as integrated smart community.

The achievement of paper objectives requires using the existing maps, plans and previous studies which discussed concept of smart city and the plans of smart village in Egypt , in addition to taking some opinion of investors, workers and residents in the Smart Village about their satisfaction with available services, activities and means of communication in order to support the evaluation process which uses comparative analysis approach to compare between the theoretical indicators and the main characteristics of case study for determination the gap between them and put the required indicators to complete the Smart community components.

Definition of smart city

The concept of smart cities has emerged during the last few years as a result of rapid development in new technologies and innovation processes which help city to use these developments in all its elements to achieve a good performance for it. Deakin showed through his study that smart city means intelligent management in several dimension, essentially in environmental, economic and social dimensions to solve many problems of these communities. (Deakin and Allwinkle,2007). Komninos added that the degree of intelligence differs from city to city according to the level of using technology in all aspects of life. (Komninos ,2002), and he refers to the main requirements for applying the concept of smart in cities focus on six main axes or dimensions such as (smart economy – smart people – smart governance – smart mobility – smart environment – smart living) to cover all important characteristics of smart city.

Characteristics, factors and indicators of smart city (CFI):

Smart city has six main characteristics which are measured by some factors and indicators to identify the degree of achievement the concept of smart and the coverage of their components as shown in the following points and table (1):

Smart economy:

Smart economy refers to the economy which depends on technology and information in the production process to achieve maximum profit and low cost as possible. Smart economy classifies to different types of activities such as (activities which use only ICT without produce it - activities which produce ICT without use it - activities which produce and involve ICT in their production processes) (Glaeser and Berry,2006), and it is necessary to exist all previous types to make integration in the cities through taking some factors and indicators in consideration as shown in the following points:

Using ICT in business:

Companies and jobs are main parts of economic structure of cities, and it becomes smart when companies and activities use ICT and change their work organization with having computers and internet connection to make their work fast and efficient. Smart economy has large market range for activities compared to traditional activities by the diversity of production and the facilitation of buying and selling through implementation some indicators which must be available in the smart economy such as (Glaeser and Berry, 2006):
- PC and Internet usage in enterprises, companies and electronic commerce.
- Information integration between economic activities.

Financial promotion:

Economic development in any city needs the financial resources for supporting economic sectors especially, industrial activities which based on technology, innovation and creativity. These financial resources are provided by local development agencies that play a main role in putting strategic plans for economic development in cities. This factor is measured by some indicators such as:
- Existence of local development agencies.
- Formulation of strategic plan for economic development in cities.
- Availability of appropriate funding sources.

Encouraging the creativity:

The main factor of smart economy is attracting talent and promoting creativity by encouragement citizens and employees to create and innovate in their economic institutions by providing suitable environment for researches and innovation in companies, especially small and medium companies to be included within the framework of the smart economy (Odendal,2003).

Support for entrepreneurship:

Supporting the entrepreneurship helps the economy system to increase its competitiveness in the present and future through organizing workshops about awareness, training, ways of development and advices for innovative projects. (Hollands,2008).

Development of Business spaces:

Smart cities must provide infrastructure and facilities for smart business activities which need enough spaces and special needs such as appropriate locations with means of communication for science or technology parks, industrial parks and business incubators , therefore this factor is measured by the following indicators (Glaeser and Berry, 2006):
- Existence of science, technology parks and industrial parks.
- Concentration of companies and services for business men.

Internationalization:

Internationalization means that the cities need to restructure their economic activities through effective strategies to join with global exchange circuits. In order to achieve the internationalization, cities must offer a network of economic activities which are linked internationally with foreign companies in other countries. Some indicators measure this factor as shown in the following points:

- International promotion strategy for the city.
- Development of flagship projects for improvement the city's international position.
- Participation in international networks.

Smart people:

People are an essential component in smart city, because they formulate the social side of cities through their characteristics, skills, creativity and their social relations with others that help city to be open with outside world .Therefore they are used to differentiate between smart and digital City. It is necessary to take some factors and indicators in consideration to judge that people are smart people or not, as shown in the following points (Baron et al; 2000):

Education and Training:

Smart people term means well educated and trained people that help them to deal with new technologies. Consequently smart city must provide universities areas for education and rehabilitation, in addition to link between the kind of university education and the requirements of working with the technological institutions. Some indicators determine this factor such as:

- Existence of Population with college degrees.
- Presence of universities in the City.
- Priority areas for educational institutions.
- Rehabilitation of current employment.
- Compliance with Market demand.

E-Learning:

As a result of rapid developments in technology and its importance in all aspects of life, it would be necessary to make attention to E- learning through design digital development plans in schools and universities to improve the digital skills of students and teachers. E-learning or virtual education offers many future benefits such as reduced costs ant time, flexible hours and greater interaction. Therefore this factor is determined by some indicators such as (Caragliu et al ;2009):

- Existence Plans for digital development in classrooms.
- Penetration of ICT use in education.
- Implementation of E-learning programs.
- Life – long training for students and teachers.

Human capital:

Current and future development of human capital plays a main role in achieving smart people in cities, this kind of development depends on existence of knowledge centers which train and help them to be useful for their society. These knowledge centers try to make cooperation with different companies to improve their courses and ways of education to be suitable for the new needs of market. So collaboration between companies and knowledge centers is the main indicator of this factor (Berry and Glaeser, 2005).

Smart Governance:

Smart governance includes active political participation, existence of citizenship services, using ICT in city management and using new communication channels between government and citizens that called e-government or "e-democracy". To apply smart governance in cities, there are some factors that must be taken in consideration such as (Coe et al; 2001; Paskaleva, 2009):

Local public spending on ICT:

The new direction of investment is investment in ICT due to its significance for all economic sectors and public administration. Therefore it is necessary to allocate part of the local public spending for investment in the field of technology and information to achieve the intelligent management of the city.

Website availability:

Smart governance based on the new means of communication such as internet which become a major channel of communication with public through website availability for governmental institutions.

Strategic plans to promote e-Government and ICT:

Smart cities need to develop strategic plans related to rapid development in information and technology, such as e-government action plan instead of followed traditional plans in public administration (Torres et al; 2005).

On-line public services:

On- line public services help public administration to improve the productivity and quality of the services which are offered to citizens and businesses, also it provide an access to government services at any time and place in a more convenient, personalized, faster and less expensive manner. According to that there are some indicators which determine this factor such as (Silva et al; 2012):

- Percentage of available on-line services.
- Major of public services offered by cities on-line.
- Administration staff that use internet-connected computers.

Transparent governance:

Using new technologies in public administration help to provide information and data which achieve transparency governance, for example the availability of municipal plans, regulations and budgets to individuals and companies.

E-Democracy:

New technologies play a main role in increasing opportunities for individuals and communities to interact with government, also it enables citizens to participate in some decisions at any time from any place and achievement new form of democracy called electronic democracy. To measure that we can use the following indicators (Deakin, 2010):

- Citizen participation in all fields.
- Electronic voting.

Promoting ICT and Innovation:

Smart cities must raise the awareness of importance of ICT and innovation among the public and businesses through open dialogue between experts, entrepreneurs, academics, institutions and investors to discuss how cities can improve their using of ICT and face their challenges.

Smart mobility:

Smart cities use new technologies in all means of transportation and communication to make link between cities and within city components. This character depends on some factors and indicators as shown in the following points (Del and Florio, 2008):

Connectivity and ICT infrastructure:

Smart communities depend on modern communication networks like Internet network in homes, business, service institutions and different means of transportation. To measure this factor we can use the following indicators:

- Penetration of ICT use in homes.
- Internet usage.
- Broadband coverage.
- Broadband usage.
- Mobile phone usage.
- Mobile Internet usage penetration.

Public internet Access:

Smart cities must provide many points of connection to internet in all parts of the city and in public squares to make it easier for citizens to connect with internet and to get different government services instead of going to them. This internet access shows in the following points:

- Wi-Fi hotspots in cities.
- Public Internet access centers.
- Promotion deals with ISPs.

Smart environment:

Smart environment refers to use of new technologies in protection and preservation city's environment. There are some factors that must be taken in consideration to achieve smart environment such as (Deakin, M; Allwinkle, S.,2007):

Security and trust:
Using new technology of information and communication systems is necessary to achieve safety and security through invention of new ways to protect citizens in public and private areas as well as in management the incidents and crises. This factor depends on the following indicators:
- Using ICT to improve public safety.

Culture and identity:
Smart cities use new technology in promoting their culture and in transferring it to other countries to publicize their cultural identity. Also new technology is used to record their cultural heritage. To measure this factor we can use the following indicators:
- Initiatives for Electronic registration for heritage assets.

Environmental protection:
New technologies are used in environmental protection from pollution and natural disasters , in addition to management the natural resources to meet the needs of current and future generations (Komninos,2009).

Smart living:
Smart living means improving the quality of life for citizens through attention to culture, health, safety, housing, services and Infrastructure as shown in the following factors (Baron et al,2000):
- Cultural facilities.
- Health conditions.
- Individual safety.
- Housing quality.
- Education facilities.
- Infrastructure development.
- Social cohesion.

Main requirements for successful smart city:
According to characteristics, factors and indicators of smart cities that have been outlined previously, we can identify some additional necessary requirements for achievement successful smart cities as shown in figure (1) :
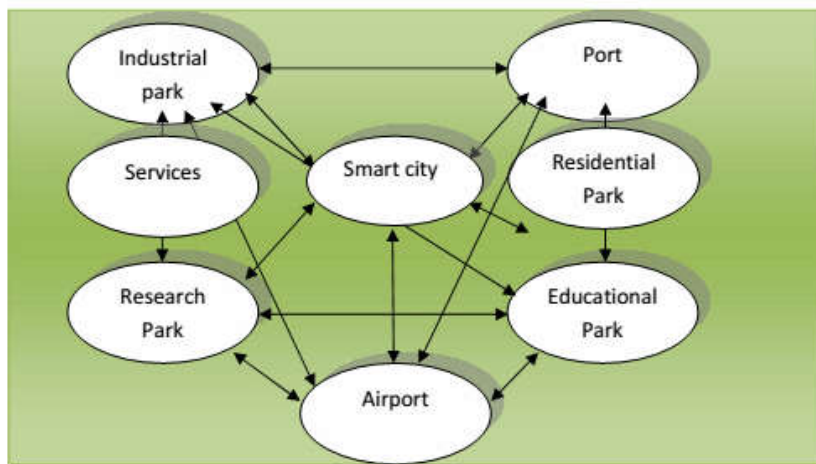

Figure 1. Requirements for Successful smart city (Source: author)

Table 1. Characteristics, factors and indicators of a smart city:

| Characteristics	Factors	Indicators
SMART ECONOMY (Competitiveness)	ICT use in businesses	- PC and Internet usage in enterprises. - Internet usage penetration for electronic commerce.
	Financial promotion	- Local development agencies. - Strategies for the economic

		development of the city.
	Retaining and attracting talent and promoting creativity	
	Support for entrepreneurship	
	Development of Business spaces	▪ Science and technology parks. ▪ Industrial parks. ▪ Business incubators.
	International embeddedness	▪ International promotion strategy for the city. ▪ Development of flagship projects for the city's international positioning. ▪ Participation in international networks.
SMART PEOPLE (Social and Human Capital)	Education and training.	▪ Population with college degrees. ▪ Presence of a University in the City. ▪ Priority areas for educational offers. ▪ Adaptation of the educational offer to the current labour ▪ market demand.
	E-Learning	▪ Plans for digital development in classrooms. ▪ Penetration of ICT use in education. ▪ Implementation of e-learning programs. ▪ Life – long training
	Human Capital	▪ Collaboration between companies and knowledge centres.
SMART GOVERNANCE (Participation)	Local Public spending on ICT. Website availability. Strategic plans to promote e-Government and ICT.	
	On-line public services.	▪ Percentage of services available on-line. ▪ Major on-line services offered by cities. ▪ Administration staff that use Internet-connected computers.
	Transparent governance.	
	e-Democracy.	▪ Citizen participation. ▪ Electronic voting.
	Promoting ICT and Innovation	
SMART MOBILITY (Transport and ICT)	Connectivity and ICT infrastructure.	▪ Penetration of ICT use in homes. ▪ Internet usage. ▪ Broadband coverage. ▪ Broadband usage. ▪ Mobile phone usage. ▪ Mobile Internet usage penetration
	Public Internet Access.	▪ Wi-Fi hotspots in cities. ▪ Public Internet access centres. ▪ Promotion deals with ISPs.
SMART ENVIRONMENT	Security and trust.	▪ Using ICT to improve public safety.

(Natural resources)	Culture and identity.	▪ Initiatives for the digitization of heritage assets.
	Environmental protection	▪ Attractively of natural conditions ▪ Pollution ▪ Environmental protection ▪ Sustainable resource management
SMART LIVING **(Quality of life)**	Cultural facilities Health conditions Individual safety Housing quality Education facilities Touristic attractively Social cohesion	

(Source: Author according to Baron et al;2000 ;Komminos , 2009 ; Deakin and Allwinkle , 2007)

Framework of application smart community indicators in case study (smart village):
The research paper relied on the descriptive approach and the comparative analysis for application the smart community indicators in the case study as shown in the following figure no (2):
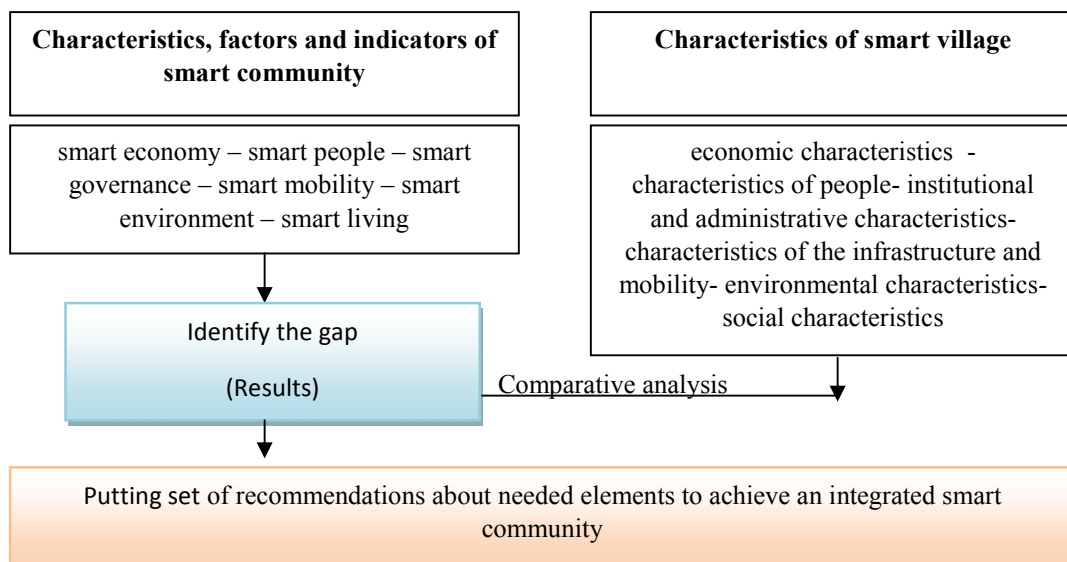

Figure 2.The methodology for implementation the smart community indicators in the case study
(Source: Author)

Smart village project:
Location and area:
Smart village is located at 10 km far from pyramids area in the intersection between (Cairo / Alexandria desert road at mark of 28.8 km) and (industrial Abu Rawash road at 8.30 km) as shown in Figure (3). It associated with some other important locations such as (international airport through the ring road – 6th of October city – Sheikh zayed city – Ahram gardens-Dreamland – Beverly Hills..) which presented many services and activities to smart village . The total site of village occupies an area of 371 acres and after the total expansion it will reach to 663 acres in accordance with the proposed plan.
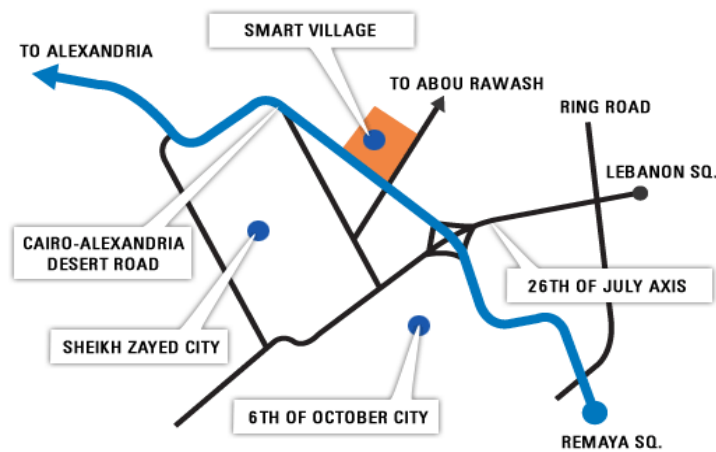
Figure 3. Location of smart village
(Source: (Ministry of Communication and Information, 2012)

The main objectives of smart village:
Smart Village was established in order to create compilation of economic activities which based on information technology in one urban place. The main objectives of creation this type of settlement are (development of Egypt to be leader in the field of information technology at international level -increasing foreign investment by attracting ICT foreign companies – encouraging local companies to build a new market of information & communication technology in Egypt- supporting trained technical workers – development the Egyptian society through support and development the culture of the community).

Concept of smart village planning:
Planning of smart village was carried out in two stages as shown in figure (4) and (5), the area of first stage occupies about 371 acres and the second stage occupies 292 acres. Smart village plan as shown in figure (6) focused on set of principles from site selection stage to the building design stage, these principles aim to achieve smart community able to emulate other smart sites in the world in ICT field, and the following points show these principles and characteristics of the plan:

Figure 4. The first stage of smart village plan
(Source :Ministry of Communication and Information, 2012)

Figure 5. the first and second stage of smart village site
(Source :Ministry of Communication and Information, 2012)

Figure 6. plan of smart village
(Source: Ministry of Communication and Information, 2012)

Current principles and Characteristics of Smart Village:
Economic characteristics of smart village:

Smart village has some economic characteristics which compatible with indicators smart cities, the following points shows these economic characteristics (Ministy of communication and information, 2012):

- Smart village attracts economic projects which based on ICT and there are many public and private businesses which use ICT to facilitate their work such as (Egypt Telecom, Egyptian post, Samsung company, Siemens company, microsoft and Orascom., figure (7) shows the examples of these businesses.

Figure 7. examples of business in smart village
(Source: Ministry of Communication and Information, 2012)

- Smart village is located near the mother city (Greater Cairo), thus it benefits from its services, infrastructure , local market and the existence of specialized technical workers.
- Existence of financial institutions such as financial exchange (stock market) to make link with central business district.
- Ministry of communications (MCIT) tends to be existed in the Smart village by establishing management center which are linked with main headquarters of the ministry in central business district.
- Investment in smart village varies between the public and the private sector , the government participation rate is up to 20% of the project area through location of Ministry of Communication and Information (MCIT), while private sector investment occupied the rest of smart village through 51 Joint-stock companies.
- Existence of link between local companies and international companies outside Egypt.
- Users of the smart village are (companies through ownership or rent system -local and international companies) and visitors who deal with these companies and get benefit from provided services such as (conferences center - exhibition centre - marketing center - information center ...).
- Smart village aims to provide about 20,000 job in basic sector of informatics and 12,000 job for services activities.
- State supports companies in the smart village by providing land plots, buildings, infrastructure and transportation system. But this support is limited and needs to direct financial resources for developing smart village through putting new vision for it.

Characteristics of people in smart village:

People in smart village are visitors who need services and information from companies and government departments, or workers who work in businesses centers and companies. Therefore the characteristics of people focus on people who come from other communities to deal or work with smart village, the following points show these characteristics (MCIT, 2012):

- Smart village is located near some urban communities which inhabited by well educated and trained people especially in technology field, Therefore they are the main source of employment in smart village.
- Training centers and research centers spread in the smart village for training and rehabilitation the employment to suit with the developments in Smart Village.
- Smart Village depends on public and private universities which located in (6th of October City, Giza and Cairo) because there are no educational services particularly in sector of information and communication technology.
- There is cooperation and coordination between some companies and knowledge centers to cover with the market demand.
- There is a need to apply e-learning system for educational and research centers to facilitate communication with knowledge centers.

Institutional and administrative characteristics of smart village:

Institutional and administrative characteristics reflect the way of city management , availability of government services and existence of institutions for planning and development as shown in the following points (MCIT, 2012):

- State is responsible for managing smart village and motivating companies to exist in the village by reducing taxes and providing different systems for acquisition the buildings (ownership and rent systems).
- Existence of specialized companies to manage the village (FMS).
- There are many administrative services such as Ministry of Communication as shown in figure (8).

Figure 8. Examples of administration services in smart village
(Source: Ministry of Communication and Information, 2012)

- Providing most of the administrative services via internet to reduce the dependence on main center in Cairo.
- State focuses on putting plans for smart village to make development and integration with surrounding communities to compete locally and internationally.
- Institutional development of smart village needs to add participation of company owners, investors and beneficiaries through development plans.

Characteristics of the infrastructure and mobility in smart village:

Smart village has special infrastructure and mobility network to keep up with the development in technologies around the world. Modern infrastructure and mobility are considered the main requirements for smart community, the following points show elements and characteristics of these networks in village (MCIT, 2012):

- Existence of VPN links (virtual private network) to transmit voice and data.
- Existence of VOIP service (voice over internet protocol) in smart village and there are two types of it (circuit switching for continuous contact between sender and receiver) and (packet switching which transmitted between the Routers).
- Video conference system.
- Availability of modern network to supply energy compatible with international standards.
- Uninterrupted energy source.
- Existence of traditional infrastructure network such as (water supply network from the station of Sheikh Zayed ,in addition to Barakat wells but smart village needs other sources to cover all needs - sewage network connected to Sheikh Zayed station - electricity supply network - Natural gas network - central network for air conditioning).
- Smart village spatially associated with Cairo international airport through the Ring Road but the distance between them is relatively far and takes more time.
- Availability of parking plots for private cars and buses above and underground.
- Businesses centers, services, companies are supported with ICT network to facilitate their functions.
- There is a connection between local information network in smart village and international information, but it needs to be developed to cover all businesses and services.

Environmental characteristics of smart village:
Design of smart village takes some environmental principles in consideration such as (MCIT, 2012):
- Using many Solar breakers in elevation of buildings.
- Using special types of glass to reduce heat inside building spaces.
- Using water elements in spaces inside building to moderate temperature.
- Putting barriers of trees (30 m in depth) to protect from unwanted wind.
- Existence of security system for disposal from solid and liquid wastes, also there is system for maintenance and management of buildings in the village to work efficiently.

Despite the previous characteristics, the design ignores other environmental elements which reflect the natural characteristics of Egyptian desert such as:
- Using kind of plants in public spaces not suitable with desert environment. This lead to turn most of green areas into desert land.
- Not using positive aspects of Egyptian environment in generation renewable solar energy instead of traditional methods.

Social characteristics of smart village:
Smart Village gets benefit from existed services in main city and surrounded communities like (6 October - Sheikh Zayed - Ahram gardens - Dreamland - Beverly Hills) , as well as there are many special services in smart village linked to its characteristics which occupied approximately 50 acres (15.7% of total project area) and are classified into two groups as shown in the following (MCIT, 2012):

Basic services:
These services directly support the main activity of smart village (informatics activities) such as:
- Business center includes all secretarial services for Businessmen.
- Legal, financial and administrative services centers for companies such as the establishment and registration of companies.
- Press center with sophisticated transport to coverage immediately all events in Egyptian telecommunications sector and international events.
- Conference center with high level of technology for all kinds of meeting as shown in figure (9).

Figure 9. Examples of conference centers in smart village
(Source: Ministry of Communication and Information, 2012)

- Center for the reception, meetings and concerts to serve the residents and visitors of smart village.
- Public library (traditional and electronic).
- International center mail service and shipping.
- Printing center for printing ,publishing and translation.

Assistance services:
Assistance services are set of services that meet the other needs of population such as:
- Marketing center includes shops and restaurants for workers in smart village.
- Car rental service to transport the people from and to airport.
- The availability of rabid bus service that transports workers and visitors.
- The availability of services for cleaning and maintenance with high technology.
- Hotels for visitors.
- Medical centers, pharmacies and health insurance.
- Security services with high-technology.
- Building for entertainment and sports

Conclusion and recommendations for future researches:

Under the evaluation of smart village according to smart communities indicators, the paper attempts to put set of findings and recommendations which are cleared by comparing theoretical indicators of smart communities with current characteristics of the Smart Village. Results of paper aim to highlight the gap after process of comparing and the recommendations suggested main requirements for development Smart Village to be an integrated smart community. The main results of paper show that smart village is business center based on ICT, and it lacks of some elements which are represented in (lack of housing areas, absence of manufacturing technology areas., limited presence of internal transportation means within village, use of non-renewable energy sources, lack of specialized educational services, lack of training centers, limited presence of international companies and non-existence of research park which help researchers for creativity and innovation in technology field).

In the other side the paper tries to formulate some recommendation to maximize the pros and reduce the con of smart village, in addition to put new vision for it to be sustainable smart community. This would be through identifing areas for future expansion, insert internet network in all services and economic activities to facilitate communication with the main centre, allocation of land plots for industrial park to manufacture technology locally, stimulate international companies to be exist in the village, support specialized educational services and research centres and also it is necessary to take sustainability dimensions in consider to achieve a sustainable smart community for current and future generation.

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