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Evaluate the efficiency of the Iraqi city to overcome the challenges of sustainable smart cities

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Abstract. The Iraqi city suffers from stagnation and being unable to respond to the increasing demand for services due to the high population density that has created a huge data system. Therefore, the traditional systems are unable to respond to the nature of demands and provide solutions according to standards that meet the ambition of the planning. The traditional choice of presenting plans and implementing them with the world's knowledge progress has become a futile choice that may not work if it continues at this classic steps.

This importance of Smart City globally and its adoption as a strategy is to alleviate the problems caused by population growth and rapid urbanization, yet, we notice a very small number of researches that discuss this phenomenon in Arab countries generally, in Iraq specifically, and in order to fill this gap and in responding to the use of this concept, the frame of this research was set to identify the most important obstacles in implementing this concept on the Iraqi city in terms of Smart infrastructure elements which is a base of the concept of smart city integration.

This research is part of the solutions to the problems of cities through smart means, which can be divided in this aspect into two main stages: the first is the studies that concern the literature that aim to establish such cities, second is the practical aspect of these kinds of literature. Therefore, the research aimed at studying the possibility of applying the literature of the smart city to the Iraqi city in order to evaluate the reality which resulted in the fact that applying this concept requires financial and knowledge abilities which suites the gap deduced by the research through adopted globally tools in this field.

1. Introduction

The planning naming has taken modern dimensions with contemporary nomenclature that corresponds to the number of the challenges facing the scheme while formulating its various policies, naming like "sustainable creative cities, knowledge cities, virtuous cities, and smart cities". A generation of professionals and developers appeared, who have focused their interests on understanding the movement of cities with its new dimension within the imagination and modern practices of planners to achieve perception, that were fiction in the past, but due to the technological development and recent studies; they become a concrete act and workable speech systems. These designations aimed to solve the problems of cities suffering from poor resources and potentials to cover the gap in this field.

The term "smart city" is gaining an increased importance, but the vision of these cities remains unclear, as many similar terms are often used as alternatives, such as knowledge cities, sustainable cities, Virtuous cities, and other names. We need to identify the key dimensions and elements that a Smart City featured by and review the various measures of urban intelligence to define a common definition of the structure of the smart city, its milestones and its execution mechanism as compared to



traditional cities. Furthermore, different measurement methods and indicators have been developed according to the various meanings of the Smart City concept. These methods work through quantitative artificial indicators to guide urban city planners and policy makers to determine the focus of both time and resources [1].

The interests in the concept of smart cities have been increased when the concept of smart cities and sustainability were merged, where the concept sustainable urban development or sustainable smart cities emerged and significantly breached urban planning and developments since the early 1990s. It is believed that any ecosystem can be described as smart and sustainable if conditions of production and growth were consistent and harmonious, whether it was human growth or activity growth. Sustainable development is essentially a form of intergenerational solidarity. This concept is rooted in whether the city (more livable, richer than before, consumes less, produces more, reduces the environmental impact of human activity, etc.) so that the next generations would have the opportunity of enjoying the same living conditions or live better [2].

2. The Smart City, History and Concept

In the middle of the nineteenth century, the concepts of urban and regional planning emerged as a reaction to the industrial cities to provide several rules to protect the natural environment from the industrial pollution that destroyed the city at that time. Hence, legislation and regulations were set to protect this environment, these legislations addressed many standards such as environmental quality, life quality, evaluate the biological diversity.... etc, which set the boundaries for urban stability and natural environments on the one hand and manufacturing sites on the other, all this was due to the planning policies back them. As a result of the success of these policies, the legislation has expanded to include all aspects of the city such as health, education, transport, communications, entertainment, energy and all other city facilities, other than infrastructure such as the economy, trade, clean industry etc.

The progress made in all fields, and as a result of creating a huge data system due to the increase of population, especially in city centers, made the traditional option of presenting and implementing the plans with the current progress of the world, a fruitless option that can't make any use if it continued the approach of inability to include all aspects of life through human capabilities without resorting to technology, here, the technology plays the role of helping the scheme to determine the potentials and resources and distribute them in such a way that ensures to fill the needs of current generations without affecting the rights of next generations and their aspirations.

Smart cities emerged in the late 1980s to represent a method of visualizing the urban context and rapid developments. Since then, smart cities are enhancing digital content and services and integrating computation. Smart cities face various challenges in different countries that seek to manage cities more efficiently, which made them an alternative approach to traditional cities through taking advantage of the different technology and communication systems that have contributed the dimensional decision-making, as it is in current smart cities in order to improve the life in cities.

The term "Smart City" was first used in the 1990s, at that time the focus was on the importance of new information and communication technology (ICT) for technology-based infrastructure inside the cities. This approach was adopted by the California Institute of Smart Communities, where the possibility of designing a smart city in which information technology is applied was studied [1].

There are many definitions addressed by most of the research dealing with the concepts of smart cities, but the general vision of this concept is concerned with establishing the process of coexistence between artificial intelligence and urban space or that is the concept that tries to achieve relation between the structure of city and the technical aspect and activates mutual support and benefits.

This is achieved through analyzing the terms and the extracting common points of interest and knowing new uses which were unmentioned previously in traditional cities thanks to modern communication technologies that enhance the innovation element of smart city structure to provide the best service to its population. Smart cities also offer the opportunity to integrate the physical infrastructure of a city as (transportation, land management, city services, and economic, social and

environmental components) with industrial intelligence in a manner that sustainably increases the efficiency of major systems in a city [3].

3. Sustainable smart cities (the construction mechanisms and the integration enhancements)

Perhaps the most important question in the concept of sustainability in urban areas is: How can we achieve urban sustainability in the context of the smart city? Or what are the mechanisms to create a smart city within the concept of sustainability? And can these concepts be viewed separately or should they be parts of an integrated concept in which both smart and sustainable policies are taken into consideration? Over the past few decades, many research organizations and institutions have produced a wide group of indicators and standards to support planners and decision-makers in order to take into account the recent developments of the Smart City and the type of interventions they provide to achieve goals of sustainability.

However, the tasks assigned to planners have become more complex since the standards and indicators previously have been restricted to the development of a specific field. The new path has been linked to technical development and technological progress [4], which has raised the question of planners to verify the set of indicators that effectively deal with new challenges facing the smart cities in the era of fast-evolving information, and investigating the adequacy of indicators of Smart City performance in terms of sustainability goals and studying the constantly changing elements in order to reach smart sustainability achievements in cities in the right manner. These questions led the planners to identify the elements of the Smart City before studying the indicators and standards of smart city establishment [5]. However, the former terminologies in their smart concepts often refer to the use of modern technology in all aspects of life, and they exceed that to the concept of innovation in this field, for example, intelligent transportation in a city deals with intelligent management of traffic systems and auto-regulating the vehicles' movement, but the innovative in the current field represented by the creation of new systems or means of transportation that facilitates the movement of people from one place to another, in addition to infrastructure, services and energy .. And others

The path of research requires identifying the most important and complex elements by specialists of this field. Many researchers summarized the elements that are involved in the formation of smart cities structure [3, 6-9] as shown in Figure 1:

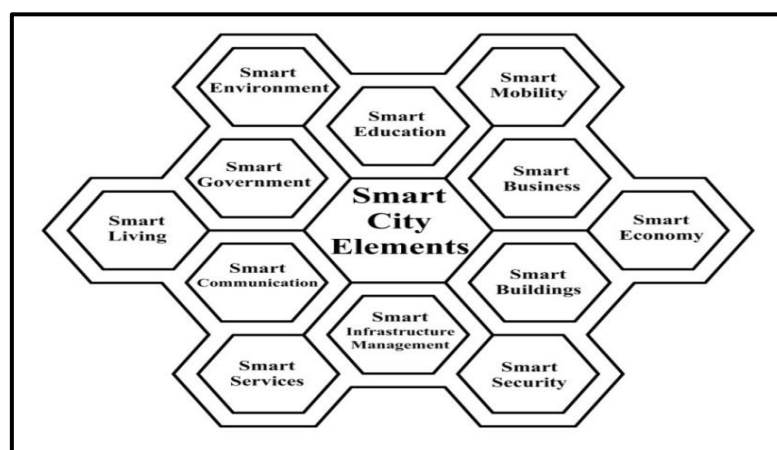


Figure 1. The elements deal with the smart city.

Data and methods of analysis are significantly increased in cities, where each aspect of the city holds sub-details and secondary dimensions as shown in Figure 2.

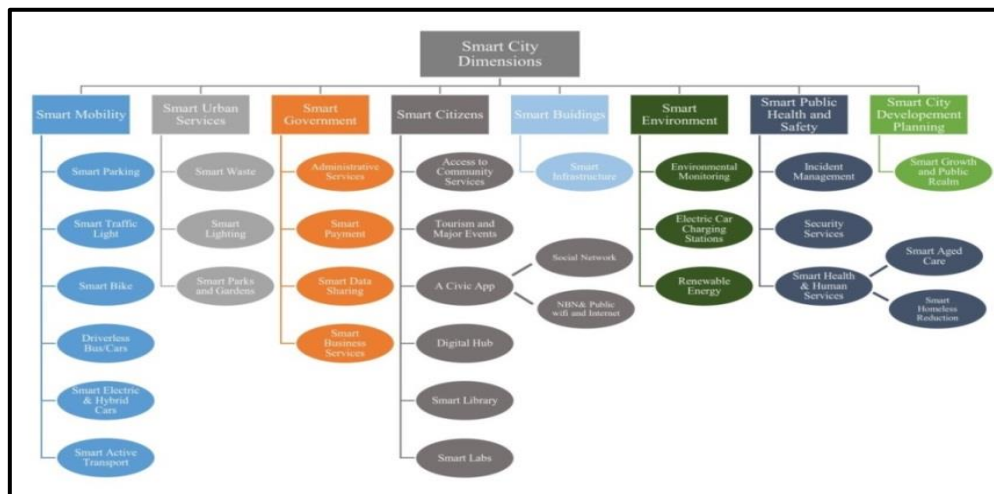


Figure 2. A model of secondary dimensions of smart city elements.

The website (Smart Cities World) has highlighted intelligence part of a city (Connectivity, Governance, Transport, Buildings, Data and Energy) [10] considering these elements the largest or most important elements in smart cities of the current time, on the one hand, or they might be comprehensive such as (Services, Citizens, Safety ... etc.) on the other hand.

The other vision of the concepts of smart cities studies the mechanism of creating and establishing this intelligence and strengthening it in a manner that ensures the sustainability of a city. The most important aspect of establishing these cities is efficient human resources, material resources, the nature of surrounding environment and the acceptance of the idea of the smart city [11], where the modern urban governments educate the concept of (Laboratories of Living Ecosystems for Urban Innovation) and how the human resources are being used to promote and activate the innovation of the population (citizens, businessmen, specialists, researchers, etc.).

Smart City governments have taken upon themselves to create the conditions and material resources for citizens to change the urban areas to the best through achieving their own ambitions by themselves. The Smart City represents a live modern eco-system of urban innovation, it is a living laboratory acts as an agent to the machine's government in the questionnaire, interpretation, and analysis to reach the requirements of growth and sustainability of the modern city.

4. The visions of Smart Cities around the world (study cases)

The integration of information and communication technology ICT in cities has generated an attention for both urban analysts and researchers. Many researchers have presented examples about benefits of establishing such cities that adopt technology to manage the country affairs, such as energy and natural resource conservation, reducing time and efforts of tasks performance, reducing material and moral losses, improving the quality and efficiency of services ... etc., subsequently, all serve the city services and increases the flexibility of work [12].

The 12 elements mentioned previously are the focus of the current research, but the main factors of accepting or rejecting these elements depend, in fact, on three major factors (human resources, material possibilities, the acceptability of the idea of artificial intelligence AI or cybernetic to manage tasks inside a city). Despite of the rejection showed by some, which was justified by a number of researches as a system that helps to uncover some issues considered as personal ones [13], in addition to the opposition presented by Pope Francis who said in his periodic letter: "The problem lies not in the technology itself, but its use represents a danger to human progress because it imprints the selfish logic of the human being for private profitability. Also, technology cannot replace politics, due to its inability to understand the complex relationships between various aspects of the ecosystem and society in which we live [9].

On the other hand, it seems that all actors in societies believe that technology is the solution in all aspects of life. All professionals support the use of Information and Communication Management Technology (ICT) as an assistant (not a leader) in decisions drafting and making for more secure and livable streets. Interestingly, even if it is unclear how some technological systems contribute to managing AI-based cities, yet, technology adoption is viewed as a sign of success. But technology itself cannot be considered a standard of intelligence, where the misuse of technology in cities will not serve the population and the visual urban feature of buildings that are surrounded by attractive neon, this may not be an indicator or intelligence, on the other hand, the movement without vehicles (movements of passers-by) is a part of smart city structure if this type of movement was planned in a smart manner to integrate with other transportation [14].

Perhaps the most distinguished experiences of Smart City project are mainly found in the developed countries that were identified by Smart Cities World website in the cities (Barcelona – Spain, Bristol – England, Dubai – United Arab Emirates, London – United Kingdom, Los Angeles – United State, Manchester – England, Moscow – Russia and Paris – France ... etc.). The concept of technology wasn't included in the basis of establishing these cities, rather it focused on two elements: population size and total output, considering that the greatest challenges that face the transformation of cities into smart cities are Human capital and the sharing of experience resulting from society, since these two elements attract the technology required by such cities [15]. Despite the emergence of innovative ideas in the Iraqi cities, yet, they suffer the lack of an effective system that links these ideas and transform them into intelligent systems, or preserving and transferring them, and providing the skills required to develop these ideas. As consequence of these two reasons, innovation is the central issue in the emergence of the Smart City. Smart planning is also required not only to attract talent but to preserve it, since the existence of many talented people in these cities is considered to be temporary due to the circumstances the country is going through and factors that motivate such people to immigrate, accordingly, the necessity of finding innovative solution for human capital and population's contribution emerges. Without these solutions, the economic, environmental and social sustainability that is necessary for a smart city would be difficult to achieve.

It should be mentioned that the process of constructing a smart city in Iraq should exceed the phases taken by the developed cities or follow the same steps adopted by previous smart cities, and perhaps the leading principle of this field depends on using common resources that benefit a progressive construction process through planning (Smart city technology infrastructure) for example, and then build databases for communication (connectivity) as a second stage. Then, the tasks of implementing the smart city will be carried out according to the priority and in such a manner that ensures a mutual service adopting the principle of accumulated benefits reaching Smart Governance, at that stage the AI which was established in the previous stages will accelerate the work to achieve a complete smart city [16].



Figure 3. Phases of establishing a smart city.

5. Evaluating the performance of Iraqi cities to overcome the gap

The elements of the Smart City are conceptual dimensions that can be used as evaluation tools in our experimental model since their sub-dimensions are related to the precise details of the city structure. These elements correspond to the importance of the structure of an Iraqi city and its influential strength. However, the large number of elements that should be implemented in a smart city on one hand, and weakness a given city structure to accepted these elements at once, on the other hand, may form an obstacle in the application of intelligence on the Iraqi city. Accordingly, the most important two challenges face the transformations of smart cities are (capital and efficient human resources) as they are considered to be the generators of intelligence in modern cities. Therefore, the analysis was limited to these two elements (as external factors) since they do not affect the service delivery.

A study of the possibility of achieving the first stage of the smart city construction as described in Figure 3 which represent the infrastructure (as internal factors) was added to them. Studying the possibility of achieving all stages may be imaginary at the current time, because of the problems experienced by Iraq in the previous phase and the lack of clarity of vision among the decision-makers and the single-sided opinion in some cases as a result of blocs in Iraq at the current time.

5.1 SWOT analysis

SWOT analysis is a term used in human development, marketing, business management, project evaluation and planning fields [17]. The term was introduced at the Stanford Institute and was carried out to investigate the causes of central planning failure in the 1970s. The focus of this analysis was on studying the positive and negative aspects of a given project. It should be noted that its requirements vary due to the depth and complexity of the objective of this analysis. The purpose of this analysis is to identify positive forces working together and potential problems that must be addressed or at least perceived to implement the project with minimal effort and time, using the internal power and external opportunities to overcome internal weaknesses and external threats. The SWOT approach has been adopted for strategic analysis as one of the key basis of a given project and plans evaluation, through analyzing strengths and weaknesses in the internal environment on the one hand, and opportunities and threats in external environment on the other. As shown in Figure 4.



Figure 4. A model of SWOT analysis [18]

5.2 Data collection and analysis.

The data collected in the analysis below were obtained through questionnaires, personal interviews, documents and reports from the relevant institutions. The analyses were conducted with the assistance of Remark Office program. Also, major weights were given, they ranged between (1 - 10), while these weights were evaluated by Minor rates of each major element as percentages, according to the following mechanism:

- Determine the weight of each major element in the internal factors according to its strategic importance, considering that the total weights must not exceed 100 units.

- Determining the percentage of each sub-element (through relevance depending on the questionnaires) so that given percentages represent the amount of influence of the internal factors on strength on one hand and weakness on the other hand. For example, if 80% is given, this means that there are 80% of strong points and 20% of weak points, which has reduced the possibility of implementing this smart activity in the city within the given proportion.
- The score is calculated by multiplying Weight by rate.
- The external factors of the two elements (capital and efficient Human resources) are given weight, that his weight is no more than 100 units, depending on statistics and interviews, considering ability of human resources to gain experience to implement the internal elements represented by the four infrastructure within the medium-term plans, and the time required to equip the required devices and equipment to establish this city within a given time.
- Compare the values of external and the internal factors to show the possibility of implementing a smart city in Baghdad within a medium-term plan.
- Note that the weights of internal factors indicate the amount of gap in the infrastructure between the reality and the implementation of Baghdad city.

Depending on the previous notes, data were collected, tabulated and analyzed as showing in the following tables and charts.

5.2.1 Transportation

Table 1. The most important elements of smart transportation depending on questionnaires and interviews.

Service		Major Elements	Seq.	Minor Elements	Major Weight %	Minor rate %	score	Sum.	
Smart Transportation	Internal	Managing traffic and providing the service intelligently	1	Traffic lights	50	20	20	39	
			2	Speed control		0			
			3	Public roads instructions		10			
			4	Locating vehicles		10			
		Smart collection service	1	Smart collection in public transportation	20	15	11		
			2	Smart collection for private parks		30			
			3	Smart collection in gas stations		10			
			4	Smart collection when passing on private roads		0			
		Smart car parks	1	Robotic management to regulate vehicles	5	10	0.5		
	2		Smart safety procedures	0					
	3		Controlling the number of vehicles, locate them and follow them while parking	0					
	Smart security for vehicles movement and handling the violations and incidents		1	Smart screens of safety instructions		25			10
		2	Detect violating vehicles	10					
		3	Locating incidents	10					
		4	Managing emergencies	0					
	External	Capital	--	---	40	100	61		61
		Efficient human resources	--	---	60	35			

And the below schema shows the data from the table (1) above.

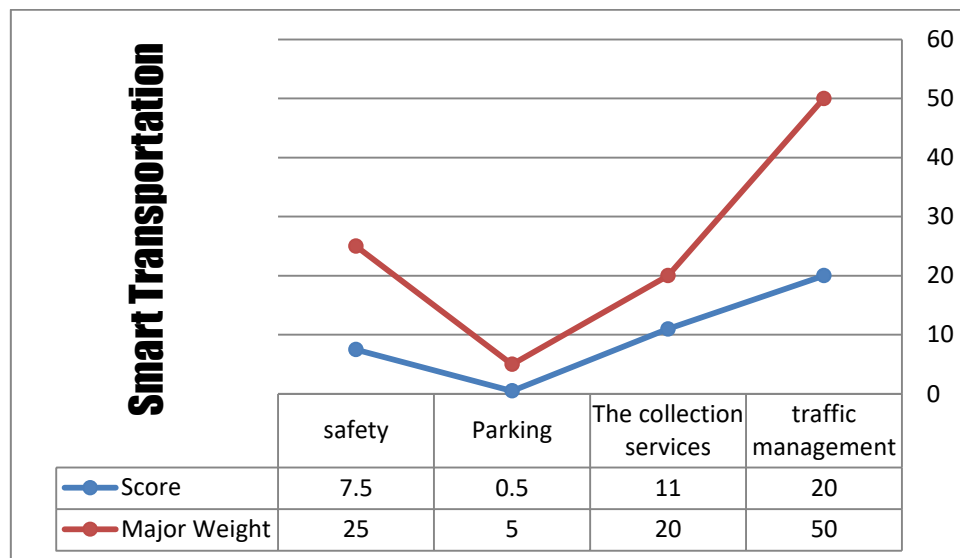


Figure 5. The gap between the reality and ambition of smart transportation service.

5.2.2 Public services (water, electricity, gas, and telephone)

Table 2. The smart elements of public service (most essentials) depending on Questionnaires and interviews.

Service	Major Elements	Seq.	Minor Elements	Major Weight %	Minor rate %	score	Sum.
Smart Public Services	Intelligent management of service providence and control	1	Creating smart databases	60	22	37.2	66.2
		2	The use of techniques and smart devices		35		
		3	Control consumption rates		5		
	Smart Collection	1	Smart collection of electricity service	20	10	16	
		2	Smart collection of gas service		0		
		3	Smart collection of water service		5		
		4	Smart collection of communication service		65		
	Safety procedures and smart crises management	1	Managing and locating the fire, gas leakage, and electrical problems	20	5	13	
		2	Using smart firefighting systems		15		
		3	Adopting techniques of solving the problems in electricity and natural Gas networks		10		
		4	Smart communication among civil defence crops during emergencies		35		
External	Capital	--	---	50	80	40	70
	Efficient human resources	--	---	50	60	30	

The below schema exhibits the data of table 2 above



Figure 6. The gap between the reality and the ambition of smart public services (water, electricity, gas, and phone).

5.2.3 Education

Table 3. Smart education elements (most important) depending on questionnaires and interviews

Service	Major Elements	Seq.	Minor Elements	Major Weight	Minor rate	score	Sum.		
Smart Education	Using smart education methods	1	AI-based Curriculums	60	25	42	50.5		
		2	Smart methods, tools and programs		40				
		3	Smart students – teachers communication methods		5				
	Managing students through AI	1	A database for teachers	5	25	3			
		2	A database about students and their families		15				
		3	Smart communication among students themselves, between students and teachers, between teachers and management and between teachers and students' parents		20				
	Smart test systems	1	Smart hall exam	25	0	2.5			
		2	Smart question forms		5				
		3	Correcting answers using smart software and devices		5				
	Providing smart services for appliance and graduates	1	Smart appliances and approvals	10	15	3			
		2	Checking documentation		10				
		3	Issuing and certifying required documentation		5				
	External	Capital	--	---	30	100		30	82.5
		Efficient human resources	--	---	70	75		52.5	

The schema below exhibits the data of table 3 above.

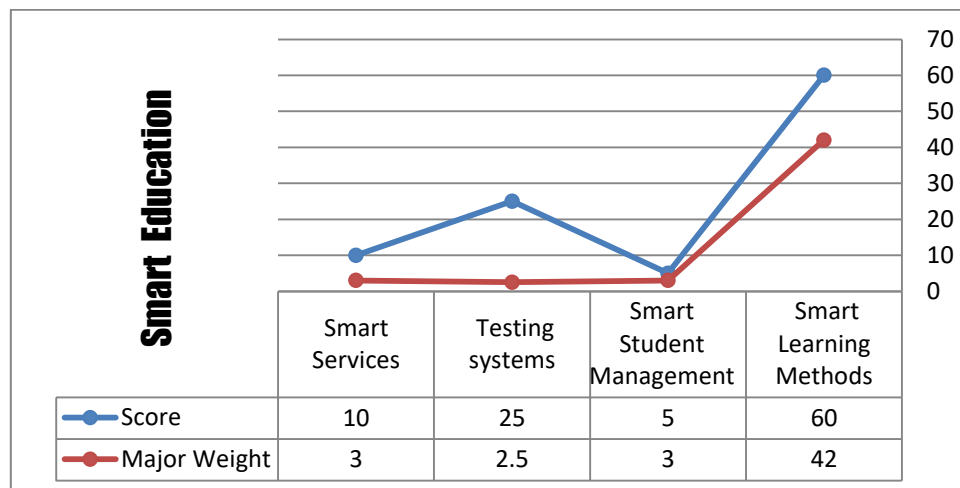


Figure 7. The gap between the reality and the ambition of smart education services.

5.2.4 Health sector

Table 4. Shows the most important elements of smart health depending on questionnaires and interviews.

Service	Major Elements	Seq.	Minor Elements	Major Weight	Minor rate	score	Sum.	
Smart Health Care	Smart collection and health insurance	1	Patients' receipts for accessing the hospital	5	0	1.5	49.75	
		2	Health insurance collection		20			
		3	Drugs collection		10			
	Smart health techniques	1	Smart examination devices	75	35	41.25		
		2	Smart assistance tools		5			
		3	Prostheses techniques and smart human devices		15			
	Smart communication means	1	Communication between patient and doctor	20	10	7		
		2	knowledge communication among health institutions of different specialties to diagnose difficult cases		20			
		3	Communication means to manage emergencies		5			
	External	Capital	--	---	20	100	20	68
		Efficient human resources	--	---	80	60	48	

The schema below exhibits the data of table 4 above.

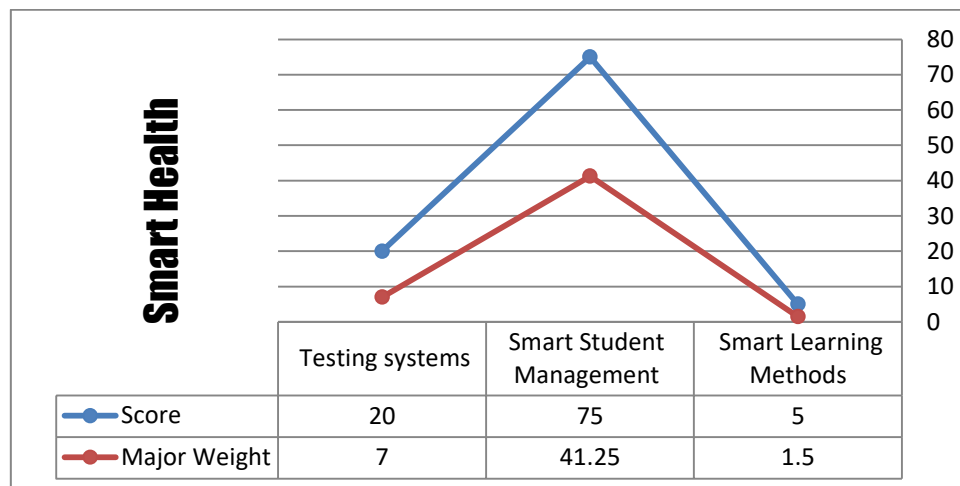


Figure 8. The gap between the reality and ambition of smart health services

The four tables above gave data on internal and external factors and the effect of the sub-components of the selected services in order to present a smart city. All that relying on the material and human resources to achieve the four service-related objectives which are considered the most important in the first stage, results are shown in table 5.

Table 5. Total weight of the internal and external factors.

No.	Smart Elements	Internal	External	Required
1	Smart transportation	39	61	100
2	Smart Services	66.2	70	100
3	Smart Education	50.5	82.5	100
4	Smart Health	49.75	68	100

Figure 9 below shows the gap between the reality and ambition for internal and external factors.

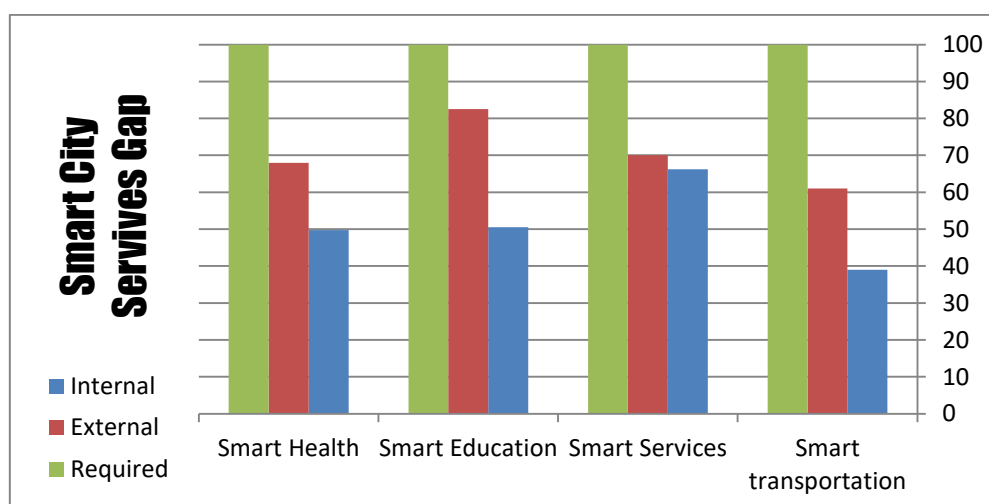


Figure 9. The gap between the reality and ambition to make Baghdad a smart city.

5.3 Discussion of Tables & Charts

The previous tables showed that there is somehow, an encouraging external environment, but there are many weaknesses in the internal environment that require strategies, plans, and programs to address their imbalance points. The internal environment indicates strength elements of transportation and smart communications sectors that occupy 39%, while the weakness is 61%, which constitutes a serious danger if it continues at this pace, as well as the lack of transportation means alternative to the road network, where the Assessments of this aspect were limited to the urban road network exclusively.

On the other hand, we note that public services (water, electricity, gas, telephone) are managed intelligently at an acceptable rate up to 66%, but generally, the Iraqi city lacks the providence of this, which identifies an indicator and a reason to the declined intelligence of this the side.

As to education and health, the general nature of these services is relatively consistent in terms of efficient human resources. They often do not require very large financial resources compared to the available capital, in fact, they need to combine the efforts of competencies to overcome this gap.

In the end, it is necessary to seize the available opportunities to overcome the imbalance in the internal elements through utilizing the capabilities exist in the external elements and make it an integrated system through building it as an interim construction so that each part is complementary to the other as mentioned in the research body.

6. Conclusion

The policies of the material resources distribution lack clarity of vision, despite their availability at a wide scale, as a result of fluctuating oil prices since it is the main supplier of funding in Iraq, as well as inaction of implementing plans set by the concerned authorities, headed by the Ministry of Planning because of the economic, political and investment factors that plague the country from time to time.

In our analysis of reality of human resources and depending on research data, we find that many of these resources lack the appropriate organization due to the widespread phenomenon (the wrong person in the right place) as a result of quotas that swept the country for decades.

Therefore, we call upon decision-makers to adopt clear policies that support the development of the capabilities of the Iraqi city in proportion to the extent of the knowledge progress in this field. From the current study of the actual performance and current capabilities, and comparing the current form of Baghdad with what we hope to reach (the gap), it was concluded that achieving a smart city requires only following the footsteps of developed countries and the help of institutions and companies of expertise in these fields, where what we need in the early stages is a combination of efforts to achieve the required.

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