



# Evaluation of Existing Road Technologies and the Impact of Management of It to Achieving Smart Cities in Iraq

Huda Mohammed Ali Hashim Al-Haboobi<sup>1,\*</sup>, Redvan Ghasemlounia<sup>2</sup>

<sup>1</sup>Engineering Management Program, Institute of Science and Technology, Istanbul Gedik University, Istanbul, Turkey

<sup>2</sup>Engineering Faculty, Department of Civil Engineering, Istanbul Gedik University, Istanbul, Turkey

## Email address:

181281015@stu.gedik.edu.tr (H. M. A. H. Al-Haboobi), redvan.ghasemlounia@gedik.edu.tr (R. Ghasemlounia)

\*Corresponding author

## To cite this article:

Huda Mohammed Ali Hashim Al-Haboobi, Redvan Ghasemlounia. Evaluation of Existing Road Technologies and the Impact of Management of It to Achieving Smart Cities in Iraq. *Applied Engineering*. Vol. 5, No. 1, 2021, pp. 1-6. doi: 10.11648/j.ae.20210501.14

**Received:** March 4, 2021; **Accepted:** March 24, 2021; **Published:** March 30, 2021

---

**Abstract:** The concept of technologies roads in smart cities is one of the concepts that have emerged recently in the developed world, which lacks application in the roads of our Iraqi country, despite its possession of the qualifications that enable it to keep pace with the developed world. In addition, there is a government rise in road construction and maintenance. As well as environmental concerns about reducing pollution and greenhouse gas emissions. Therefore, the main objective is to provide a comprehensive review of the idea of new technologies in roads as well as their various applications in the developed countries of the world, by focusing on smart uses of technology management and advanced technological systems that are important signs of progress. It has been recently conducted in the field of design and construction which not only accommodates major developments in building technology but also provides physical and environmental improvement to its occupants and provides areas where traditional services in construction are more diversified, efficient, sophisticated, and competitive through the use of technology to enhance city operations for the benefit of their inhabitants and the advantages of their application on roads Iraq to turn it into smart cities. This paper deals with two different cases in studying the use of new materials in establishing modern roads in smart cities. The first is to use plastic methods and the other is to use paints for glow-in-the-dark roads. The questionnaire was used to analyze the results of the study on 60 samples of engineers of different disciplines and ages. The results of the questionnaire used in the study indicate the utmost importance to refer to technological methods in the field of roads in developed countries that recognize the need for technology as a key to environmentally friendly, sustainable, and effective reform methods and their implementation in our country.

**Keywords:** Innovation, Smart Cities, Technologies in Roads, The Developed World

---

## 1. Introduction

The main problem in smart cities and technology in the road sector and the delay in launching and adopting their applications in Iraqi cities. On the other hand, the lack of a clear urban policy to take advantage of modern technologies in planning current and future ways to develop our country. Whereas in smart cities road management is a complex business in accelerating urbanization. Accordingly, the concept of the following question comes to mind. What are the practical applications and modern strategies in the countries of the world needed to convert some Iraqi roads into smart ones? The paper deals with issues of technical development in road construction in various countries of the world, which are

considered to be a high-speed development, and the need to make the most of the positive effects of this development in the field of development and planning in the roads of Iraq. Several researchers have shown that increasing technological awareness in the road invention industry by increasing the exchange of information between different developing and developed countries around the world provides new options for possibilities to support a wider awareness of innovation in the services or products used to achieve effective improvement in road supervision and management [1-4].

However, some experts believe that the innovation process in the construction industry is extraordinary and that the construction industry is slow to change. Regardless of this point of view, the concept of innovation in the road construction industry is already in place and has been

documented by many developers and researchers [5], in fact there is ongoing interest in determining how to improve industry innovation. [6] Suggested that the process of innovation in road construction industry is required as a foundation of competitive advantage for similar organizations. [7] He emphasized that organizational competitiveness is inevitably based on regional and national arrangements for innovation in the construction industry, which are mutually dependent on government procedures and policies. As a result, given the constant and rapid changes in the commercial environment, as well as its enthusiasm, protecting competitiveness is thus an important agenda for most organizations in the construction industry.

The paper seeks to achieve the basic goal of developing strategies to transform Iraq's roads into ways with smart technologies by identifying the latest technologies used in the world to address many materials and methods in construction and their effective role in transmitting the advantage of sustainability and intelligence to it. An example of some modern method innovation projects is taken as a case study. This paper explores two different cases in the context of method innovation that includes paints for glow-in-the-dark roads and the use of plastics in road construction [8].

## 2. Literature Review

### 2.1. Concept of Smart Cities

In the last two decades, the idea of smart cities has become widely common in scientific literature, and global relations and to demonstrate this idea, it is necessary to understand why cities are deemed key elements for the future. Where cities play a primary role in the economic and social aspects of the world and have a massive impact on the environment [9]. Being smart cities means using whole obtainable technologies and products in a smart and structured style to develop urban centers that are integrated, protected, and habitable at once and the smart cities can define as a city that improves the life quality of life of its people [10].

However, several researchers discuss that quality of life may not reflect the separate component of a smart city where should have the purpose of enhancing the quality of life so that this represents the central component [11].

Can be summarized some of the benefits of smart cities as follows:

- 1) Enhance and reduce infrastructure cost and time.
- 2) Reducing operating and maintenance costs.
- 3) Optimizing new utilization opportunities that will produce future revenue.
- 4) Economically favorable and innovative planning, building, and using measures.
- 5) Reduce waste through recycling of materials and elimination of waste at construction sites.
- 6) Raise the use of environmentally friendly substances and renewable energy.
- 7) Building in regions of low ecological value, re-use of old

structures, probably modifying their task.

### 2.2. Technology in Roads

With growing globalization and the emergence of smart cities in world-developed countries, roads have become a very important infrastructure in the transport system. Where roads are a rapid-growing sector and that is why it requires innovative ideas, development of new techniques and special material. In addition, road development is very important where creativity in road construction provides important industry and community benefits. And some of these techniques can be outlined in the roads as follows:

#### 2.2.1. Plastic Roads

Elimination of plastic waste is a big problem where it is the non-biodegradable substance that causes environmental contamination and problems such as cancer, in addition to the pollution generated by traditional conventional asphalt road construction and its maintenance, that is caused plastic road have been developed [12].

The Netherlands consider is the leading country is doing an experimental study of making a new type of road that is more credible and simpler by using recycled plastic. It can summarize the benefits of plastic roads as followed:

- 1) Creativity is green as the substance used on these roads is entirely recycled.
- 2) According to an environmental report, 2% of all road emissions is 106 m tons of CO<sub>2</sub> emissions due to asphalt, which can also be removed in this case.
- 3) Bear a much higher temperature variance and requires less upkeep too, as compared to ordinary asphalt roads.
- 4) These kinds of roads are so simple to make and have three times more life than regular roads.
- 5) Hollow design allows easy convenient access to cables and pipelines as in Figure 1.



Figure 1. Recycled plastic roads [13].

- 6) When designing plastic roads, it found its great excellence over asphalt roads in a variety of main economic aspects of technology, and road pavement achievements, as illustrates in table 1.

**Table 1.** Comparison between asphalt roadways and plastic.

Surface features	Plastic ways	Asphalt ways
Modular for faster installation and maintenance	*****	
Long-life span-up to three times	*****	
Sustainable from recycled materials	*****	
Lightweights	*****	
Passed the time test		*****
Mass production and use of experience		*****
A flat place for driving and walking	*****	*****
Rough to allow skid and traction resistance	*****	*****
Can be engineered and designed	*****	*****
Water can be treated, stored, or moved	*****	*****
Doesn't soften at high temperatures	*****	
Impervious to a pothole	*****	

Source: [14]

- 7) As the roads of plastic are placed directly on the surface floor of sand, there no need for a base, and that means less of a need for heavy construction on location.
- 8) Lightweight.
- 9) Greater life expectancy because they are homogeneous and prefab.
- 10) Time-saving for quicker building.
- 11) The damaged element can be easily substituted and refurbished or recycled into a new element, which leads to a long-life expectancy where it contributes to a circular economy [15].
- 12) It has better potential for eliminating noise.
- 13) less upkeep because the substance is very resistant to diverse environmental conditions and weeds.

On the other side, some of the problems in these roads are that plastic can be more slippery contrasted to asphalt roads, which able to be solved by roughening the plastic surface. Volker Wessels is the first construction company in the Netherlands and is the first to raise awareness of plastic roads. where it was said that the roads made of plastic would be practically upkeeping free product as weather and corrosion would not affect much and roads are going to be good in the cold temperatures of -40°F and it able also handle extreme temperatures like 176°F, as well as that road, will last longer than ordinary roads because of their hardness and it discovers that those kinds of roads are very simple to make and have three times as much life as ordinary roads [13].

It is worth mention that the implementation of the first road of plastic bags and glass in southern Australia [8].

### 2.2.2. The Glow-in-the Dark Roads

One of the main tasks for drivers is to follow the road. During the day, when the visibility on the roads under good weather is undisturbed, it is not difficult. Compared to drive at night on unlighted roads. As a consequence, drivers often complain about insufficient lighting in the terms of night driving. For this reason, Dutch discovery came to be revolutionary discovery by doing development a highway that looks like Tron and it glows in the dark. it is going to be the first road in the world that can shin in the dark [8].

These highways going to be painted by paint that shines without light, by absorbing energy throughout the day. These paints are able to shine for a maximum of 8 hours. This project

was awarded the best for the future concept at Dutch design awards. That this technology could replace the lighting posts that are put on the sides of the roads the highways. This technique can be a very intelligent and efficient energy conservation and saving initiative. The glow-in-the-dark roads are treated with a special photo-lionizing powder, making additional lighting unnecessary where the road will glow in the dark without being illuminated by the vehicle's headlights. The powder, charged in the daylight, shows the contours of the road at night for up to 8-10 hr. Dynamic paint becomes visible in response to temperature changes. As in Figure 2. It helps the surface of the roads to transmit relevant and suitable traffic information immediately to drivers [16].

**Figure 2.** Glowing lines and dynamic paint [17].

The economic advantages of these roads are attributed to the amount of energy that can be saved by constantly switching off the street lights with the use of glow-in-dark roads. On the other side, these roads will not only glow in the dark but will also give weather indicators to detect the effect of ice on the roads due to a new type of material for road markings, modern technologies, and new road materials. Therefore, this technique will also be used to paint markers like snowflakes over the surface of the road. These images will become visible When temperatures fall to a certain point, as in Figure 3. Where It indicating that the surface of the road is going to be slippery [17].



Figure 3. Warnings of a possible ice thanks to a special color [14].

This technology is considered to be one of the most significant innovations that can be used on modern roads instead of using electric poles to minimize the use of electrical energy that our Iraqi country has struggled with for more than 20 years. Testing of this project has already begun where a section of 500 m of the N329 Oss highway has been equipped with this technology. The name of this project is the intelligent highway Project and it is led by Daan Roosegaarde of Studio

Roosegaarde and Heijmans, who is a civil engineer in the Netherlands [8].

There are some problems related to the application of this technology, like the high cost of glow-in-the-darkness paint technology and the questionable product longevity of these devices in future this will lead to issues such as high upkeep costs for the quality of these products and their environmental impact. As this is still a test project, there is still a need to check the toxicity and environmental effects of these paints [13].

The first few hundred meters of glow-in-the-dark, the weather-indicated road will be constructed in the province of Brabant in mid-2013 [17].

### 3. Results and Discussion

The questionnaire was used to analyze the results of the study for 60 samples of engineers of different specializations and ages. The answers were summarized by several measures such as the arithmetic mean ( $\bar{x}$ ) and Cronbach to find the results of the stability of the sample. The following are the questionnaire questions for this study.

Table 2. Questions in questionnaire.

1	Do you think that living in a smart city would impact your life and can make developed people?
2	Do you agree in the era of development, we must move forward to transform our cities into smart cities by making use of the technology's countries and their dissemination and application?
3	The prefabricated building technology applied in the developed countries of the world is considered one of the smart and fast technologies of developing that must be promoted in the various areas of construction to move our cities to the management of intelligence.
4	Promoting and introducing the use of modern world technologies in-state projects such nanotechnology due to their clear impact on urbanization and sustainability
5	Do you agree we judge of modernity in cities when we see it from the first time by the appearance their skyscrapers?
6	Do you agree that there are many modern technologies in the road sector applied in the developing countries of the world that should be followed, the most important of which is the electric power generation that our country suffers from?
7	The current challenges of building smart cities in Iraq are due to the loss of awareness of, promotion, and implementation of modern technology, administrative corruption, and lack of awareness of the expertise of engineering departments.

The results of the questionnaire of the research paper can be deduced using the following measures:

#### 3.1. Arithmetic Mean ( $\bar{x}$ )

The following are the results given in Table 3 for the arithmetic mean and degree of significance as follows:

Table 3. Questionnaire results according to arithmetic mean and importance rank.

Sample (N)	$\bar{x}$		Std. Deviation	Rank
	Statistic	Std. Error		
1 60	3.92	0.13	0.98	3
2 60	4.02	0.11	0.83	1
3 60	3.87	0.15	1.14	4
4 60	3.53	0.15	1.16	6
5 60	3.48	0.13	1.02	7
6 60	3.95	0.14	1.05	2
7 60	3.73	0.13	1.01	5

Table 3 shows the results of the questionnaire questions with arithmetic mean scale. In general, what stands out from the table is that Question 2 is in the first place, and Question 6, related to road technology, is in second place. On the other hand, regarding Question 2, whose mean was 4.02, and had

the lowest deviation and error of 0.83 and 0.11 respectively, compared to the rest of the other samples, Question 6 is 3.95 for the arithmetic mean and 1.05.0.14 at the lowest deviation and error respectively, i.e. The results are positive, and the largest group supports the use of technology used in this research to develop Iraq's roads and transform our cities into smart cities. where the results can be compared in terms of importance, as shown in table 4.

Table 4. Classified according to rank.

2	First rank in importance with a mean of 4.02
6	A second rank in importance with a mean of 3.95
1	Third in importance with a mean of 3.92

Table 4 shows that the second question occupies the first place, which includes the use of developed countries' technologies to transform Iraq's cities into smart cities, while the sixth question comes in second place with regard to the importance of using technologies in developing countries and their application in the field of roads in our country. The importance of this aspect of the scientific paper that researchers can use in the field of establishing modern methods.



### 3.2. Cronbach Alpha

The other measure for finding the results of the questionnaire is the Cronbach analysis to find the stability of the sample as shown in Table 5 as follows:

Variables=1, 2, 3, 4, 5, 6, 7

Scale=all variables

Form=alpha.

The results of this scale were explained according to the following table.

**Table 5.** Summary processing by Cronbach alpha.

Cases	N	Percent (%)
Valid	60	98.4
Excluded*	1	1.6
Total	61	100

\* Listwise deletion based on all variables in the procedure.

Table 5 outlines the percentages of processing Cronbach alpha. Overall, what stands off from the graph is the use of the method listwise deletion based on all variables in the procedure and find the percentages for the excluding and valid. With regard to the percent of 60 samples and excluded to the sample 1 is 98.4 %and 1.6% respectively and the total of the sample after excluded is 61 with 100%. Finally, the results can be deduced according to table 6.

**Table 6.** Results Cronbach alpha.

Cronbach alpha	N
0.88	7

Table 6 shows that the percentage of Cronbach Alpha is 0.88. This value is considered good and acceptable by measure, and it is possible in the future to use these technologies in developing roads in Iraq and approve it by the government and companies to achieve savings in many economic, environmental aspects, reduce energy consumption, replace costly lighting electric poles and get rid of plastic waste.

## 4. Conclusions and Recommendations

The process of transforming cities into smartness in which our countries suffer from a deficiency and requires the development of smart vision, and strategies that translate into projects, and then follow that upgrading the infrastructure. The road sector is considered one of the most important issues that lack development and intelligence in its implementation and design. The use of invention processes in production and practices can lead to enormous economic gains for every country by adopting greener patterns of road construction by reducing the negative environmental impact of road construction. The use of some technologies such as highways that have a glossy coating that would enable road signs to be seen regardless of the availability of the energy source leading to a reduction in the number of injuries as well as plastic waste recycling techniques in road construction that would reduce the overall cost of road construction. And achieve savings in the national budget.

I recommend future researchers also use new technologies that improve the current construction method by adding automation and computerized control in the future to reduce the level of road accidents and the cost of their construction.

## Abbreviation

$\bar{x}$	Arithmetic mean
N	Sample
STD	Standard

## References

- [1] Hausman, A., Innovativeness among small businesses: Theory and propositions for future research. *Industrial marketing management*, 2005. 34 (8): p. 773-782.
- [2] Caerteling, J. S., et al., RETRACTED: Technology development projects in road infrastructure: The relevance of government championing behavior. 2011, Elsevier.
- [3] Lundberg, M., S. Engström, and H. Lidelöw, Diffusion of innovation in a contractor company: the impact of the social system structure on the implementation process. *Construction Innovation*, 2019. 19 (4): p. 629-652.
- [4] Ahad, M. A., et al., Enabling technologies and sustainable smart cities. *Sustainable cities and society*, 2020. 61: p. 102301.
- [5] Slaughter, E. S., Models of construction innovation. *Journal of Construction Engineering and management*, 1998. 124 (3): p. 226-231.
- [6] Panuwatwanich, K., R. A. Stewart, and S. Mohamed, Validation of an empirical model for innovation diffusion in Australian design firms. *Construction Innovation*, 2009.
- [7] Peace, S., et al., Facilitating innovation in construction. *Construction innovation*, 2010.
- [8] Oad, P., S. Kajewski, and A. Kumar, Innovation in Road Construction Industry: An Analysis of Different Case Studies. 2020.
- [9] Mori, K. and A. Christodoulou, Review of sustainability indices and indicators: Towards a new City Sustainability Index (CSI). *Environmental impact assessment review*, 2012. 32 (1): p. 94-106.
- [10] Giffinger, R., et al., City-ranking of European medium-sized cities. *Cent. Reg. Sci. Vienna UT*, 2007: p. 1-12.
- [11] Shapiro, J. M., Smart cities: quality of life, productivity, and the growth effects of human capital. *The review of economics and statistics*, 2006. 88 (2): p. 324-335.
- [12] Bale, A. S., Potential reuse of plastic waste in road construction: a review. *International Journal of Advances in Engineering & Technology (IJAET)*, 2011. 2: p. 233-236.
- [13] Oad, P. K., Innovation in the road construction sector and its benefits to the industry. 2016, Queensland University of Technology.
- [14] Hashem, S. and C. Cardño, Innovative Pavement Materials and Design: Smart Roadways and Smart Road Maintenance for the Future. 2020.

- [15] Miskolczi-Bodnár, P., The unused potential of green road pavements; Technical and economic-political obstacles of the competitiveness and spread of alternate, environmentally friendly pavement materials, and their potential solution for the future. 2020, Wien.
- [16] Koláčný, P., Inovace v silničních stavbách. 2016, České vysoké učení technické v Praze. Vypočetní a informační centrum.
- [17] Fiolić, M., M. Ščukanec, and H. Sokol. Future modern concepts for road markings. in Međunarodno znanstveno-stručno savjetovanje Planiranje i razvoj ekološki održivog prometnog sustava (ZIRP 2013): zbornik radova=International Scientific Conference Planning and development of sustainable transport system.