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# Theoretical frame work for a Cost-Effective Prototype Solution for Finance Accountability using MATLAB-GUI for Waste Management

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## ABSTRACT

*In the context of "Swachh Sarvekshan", the concept of waste management plays a very significant role in achieving the vision and mission of "Swachh Bharat Abhiyan", the clean mission of India. Focusing on the domestic waste, a project was taken up under the title "A Cost-Effective Prototype Solution for Finance Accountability using MATLAB-GUI for Waste Management" which formulated a cost-effective software solution using MATLAB-GUI for finance accountability during the administration of waste management at municipality level. Considering nine modules with nine parameters as one for each module the software formulated assists in calculation of revenues generated out of recycled and reused waste, in a flash of a moment. The project also provides a sample administration to the software designed to facilitate easy replication besides giving a few workable solutions for sustaining the enthusiasm of the citizens in following the procedures laid down for managing the waste effectively. The current article which forms part of the above project gives an insight into the history of management of waste encompassing topics such as evolution of management of waste, and the current practices followed for management of waste in India.*

**Key words:** MATLAB-GUI, Finance Accountability, Review, Software Solution

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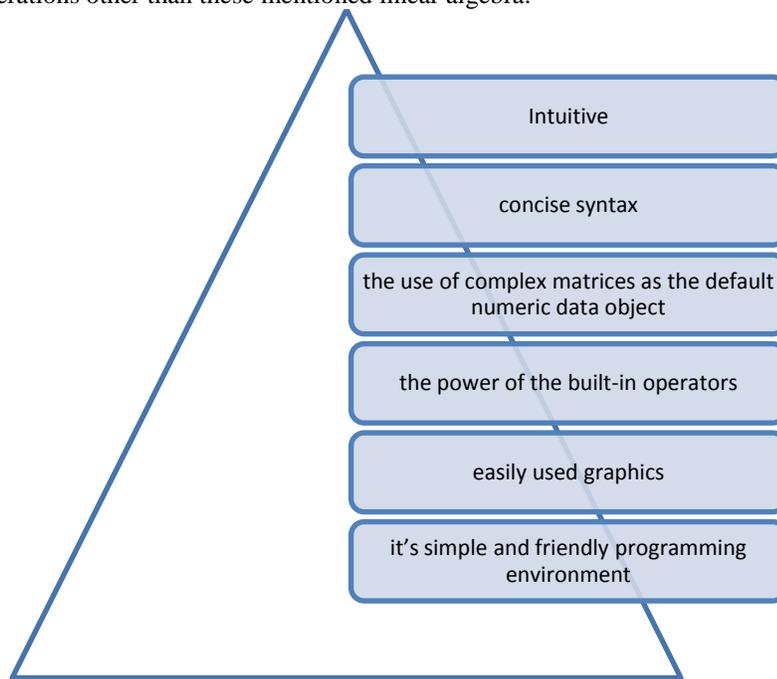
## Theoretical frame work for A Cost-Effective Prototype Solution for Finance Accountability using MATLAB-GUI for Waste Management

### 1.1 Introduction to MATLAB:

MATLAB is a programming language which is interactive facilitating a platform for scientific computing. MATLAB is widely used in varied fields for problem solving, data analysis, and for experimentation. MATLAB is software that is organized into libraries of functions called toolboxes. The works of Natick, Massachusetts, USA produces this software MATLAB and updates twice every year with versions a, b. The main reasons for MATLAB's success are:

- “Intuitive”
- “concise syntax”
- “the use of complex matrices as the default numeric data object”
- “the power of the built-in operators”
- “easily used graphics”
- “it’s simple and friendly programming environment”

The uniqueness of this software is first it takes a string and then a 2 by 2 matrix of complex numbers are assigned to the variable. The numbers used are represented as complex, double precision floating point, complex values by default. Numeric values are two-dimensional arrays (matrices) by default. Scalars and Vectors are not separate types, but are arrays with one or both dimensions equal to one. When apt, a matrix that has one (or both) dimensions equal to one is treated as a vector; one may ask for example for the inner product of a 1 by  $n$  and an  $n$  by 1 array. The methods that MATLAB offers as built-in functions include reckoning of the matrix inverse, the Eigen values, the rank, the singular value decomposition, the Moore-Penrose generalized inverse, the QR and LU factorizations, and standard operations other than these mentioned linear algebra.



**Figure: 1.1 Reasons for success of MATLAB:**

### **1.1.1 Notation of MATLAB:**

MATLAB presented some conveniences that are notational that turns it easy to express ideas about matrices more compactly than had been possible. Most noteworthy are the operations of concatenation: “[A, B] (the matrix whose columns are the columns of A followed by those of B) and [A; B] (the vertical concatenation, whose rows are the rows of A followed by those of B).” Other notational improvements comprise  $A'$  representing the transpose of the matrix A,  $A.*B$  for the Hadamard product of two matrices, and  $A \setminus b$  for the calculation of the product of the matrix inverse (A) with a vector (b). MATLAB allows a function to have several outputs, with the syntax  $[p,q,r] = f(x,y,z)$ . The  $m \times n$  ordered matrix all of whose components are 1 is created by the function  $\text{ones}(m,n)$ , while  $\text{zeros}(m,n)$  and  $\text{rand}(m,n)$  create the zero matrix and an independent matrix with uniform random elements. “The identity of order  $n$  is known in MATLAB as  $\text{eye}(n)$ .”

### **1.1.2 Evading exceptions:**

Certain mutual bugs that cause primary conclusion or impulsive performance in FORTRAN and C language programs do not perform so in MATLAB. Minus and Plus infinity are accepted values in MATLAB; they can remain as the outcome of a calculation and can be written as exact values (Inf, -Inf). Taking the benefit of the features in IEEE-754 standard for the floating point, MATLAB returns suitable values on divide by zero like  $1 / 0$  results positive infinity,  $-1 / 0$  results negative infinity, and  $0 / 0$  results Not a Number. Writing "past the end" of a matrix does not cause an error in and of itself, rather the matrix is enlarged (with zeros) to make it big enough.

### **1.2 Evolution of MATLAB:**

The MATLAB is one of the high-performance languages for technical calculations and computing. It assimilates visualization, computation and programming in a user friendly situation where anomalies and explanations are expressed in accustomed mathematical notation. Typical benefits of MATLAB-GUI consist of:

- “Math and computation”
- “Development of Algorithm”
- “Simulation, modeling and prototyping”
- “Exploration, Data analysis and visualization”
- “Graphics for scientific and engineering”

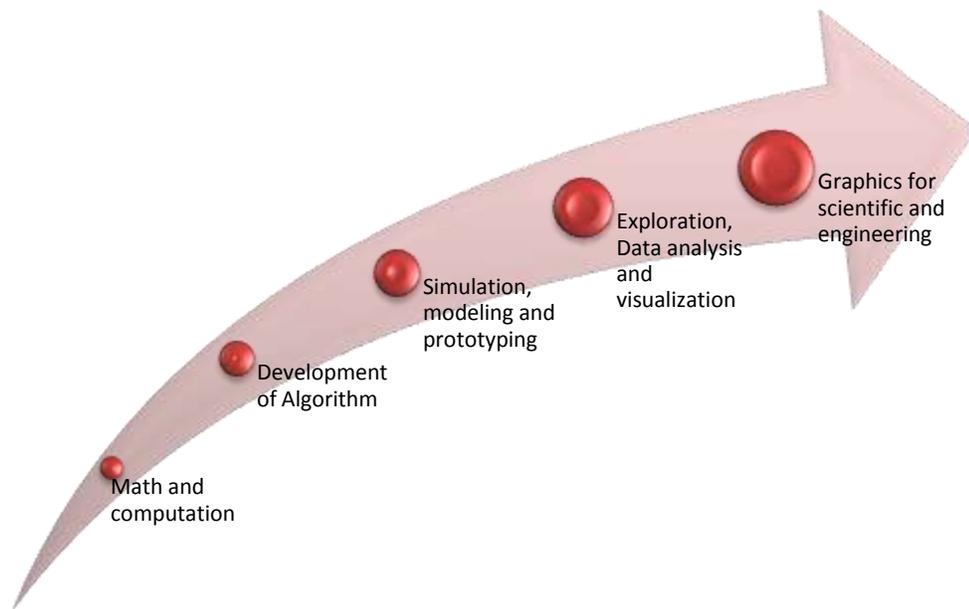


Figure: 1.2 Benefits of MATLAB

As an application of MATLAB including Graphical User Interface building, MATLAB is collaborative software whose elementary data component is an array that does not entail dimensioning. This permits resolving many computing complications, exclusively those with formulations of matrix and vector, within few seconds, once the back-end program is done.

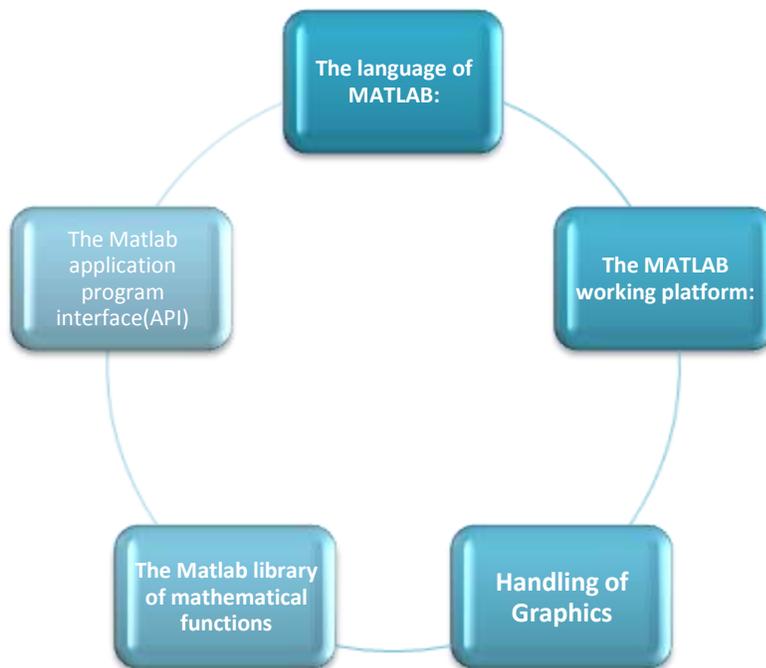
The term MATLAB stands for Matrix Laboratory. MATLAB was initially written to offer easy access to software of matrices established by the EISPACK and LINPACK projects, which composed characterize the state-of-the-art in matrix computation software. MATLAB has advanced over a period of years with the involvement from many users. In university situations, it is the typical instructional device for introductory and radical courses in mathematics, science, and engineering. In commerce, MATLAB is the tool of high-quality for high-productivity research, analysis, and development.

“MATLAB features a family of application-specific clarifications called toolboxes.” Being very noteworthy to most operators of MATLAB, these toolboxes let anyone to acquire and apply focused technology. Toolboxes are inclusive groups of MATLAB functions (M-files) that encompass the MATLAB environment to resolve specific classes of complications. Spaces in which toolboxes are accessible embrace

- Signal processing,
- Control systems,
- Neural networks,
- Fuzzy logic,
- Wavelets,
- Simulation

### **1.3 MATLAB-GUI- Advantages:**

The MATLAB System and its five key features:



**Figure: 1.3 Features of MATLAB:**

➤ **The language of MATLAB:**

This is advanced high-level matrix language with functions, control flow statements, data structures, ip/op, and object-oriented programming features. It allows both “programming in the small” to rapidly formed rapid and dirty throw-away programs, and "programming in the large" to create whole huge and complex application programs.

➤ **The MATLAB working platform:**

This is the established tool set and contains facilities that we work with as the MATLAB programmer or user. It comprises of facilities for handling the variables in our workstation and exporting and importing data. It also contains tools for managing, developing, profiling, and debugging M-files, applications of MATLAB.

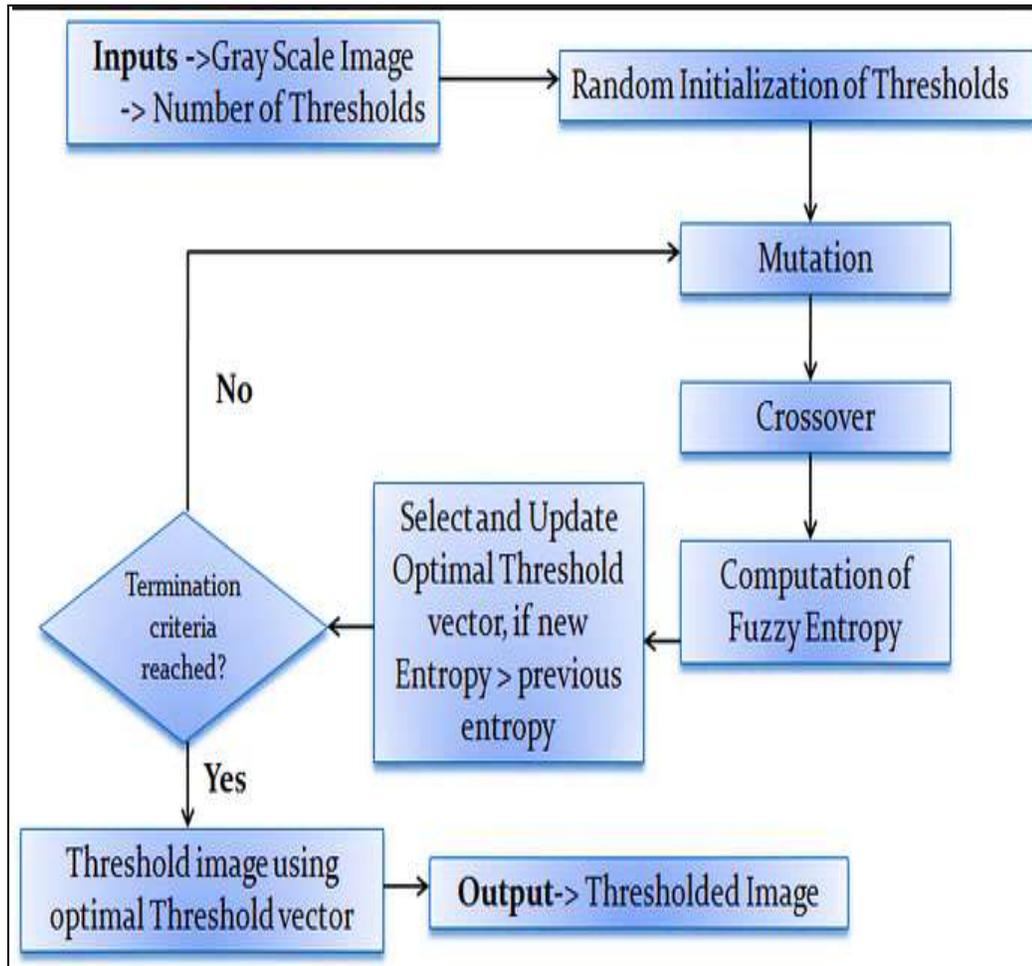


Figure: 1.4 Working of MATLAB

Source: A Fuzzy Entropy based Multi-level Image using Differential Evolution By Sujoy Paul.

➤ **Handling of Graphics:**

This is termed as the MATLAB graphics system. It embraces high-level instructions for 2-d and 3-d data visualization, animation, image processing, and graphics presentation. It also contains low-level commands that allow us to fully modify the form of graphics accompanied by building comprehensive GUI's on MATLAB applications.

➤ **The MATLAB library of mathematical functions:**

This is a massive collection of computational procedures or algorithms ranging from basic functions like trigonometric functions, sum, and complex arithmetic, to additional erudite functions like matrix eigen values, matrix inverse, fast Fourier transforms and Bessel functions.

➤ **The MATLAB Application Program Interface (API):**

This library lets writing FORTRAN programs and C that work together with MATLAB. It comprises facilities for reading and writing MAT-files and for calling procedures from MATLAB as a computational engine.

MATLAB is a very vast growing archive of built-in algorithms for computer vision applications and image processing. MATLAB approves testing algorithms instantly devoid of recompilation. Everything can be entered at the command line or execute a section in the editor which will produce the results immediately easing algorithm development. The MATLAB Desktop atmosphere, which permits working interactively with the data, aids to retain track of files and variables, and streamlines common debugging tasks.

**1.4 History and evolution of waste regulations in USA:**

There has been a drastic and evolutionary change in the practices of management of waste in every part of the globe. With the advancements in the technology and development in the societal education various modern methods have been taken shape. These advancements and modifications are different for different types of countries like developed and developing countries. Since the USA forms a part of the developed countries and is considered to be the most automated and scientific country, its waste management practices are been studied and is presented in the figure given below:

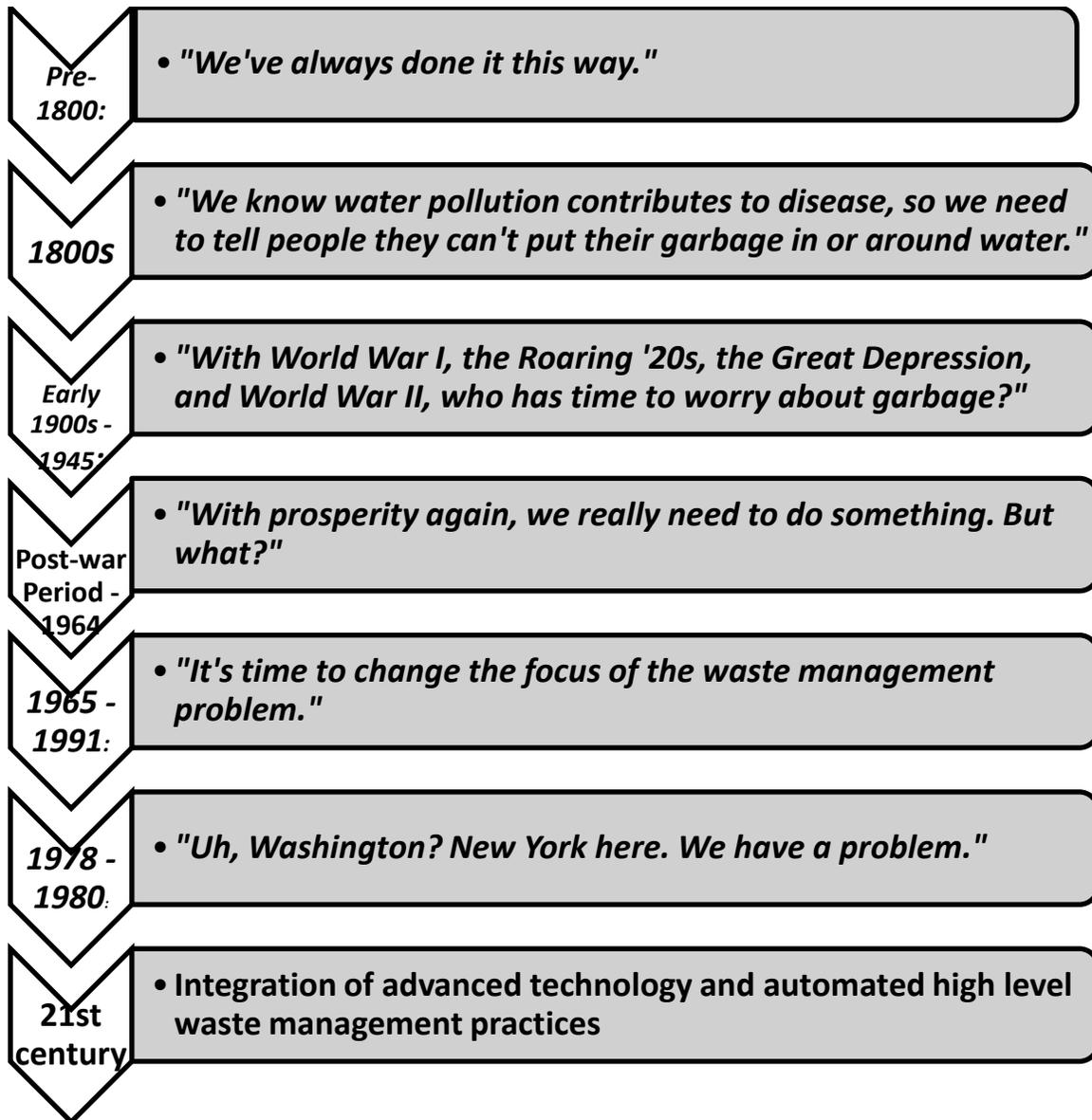


Figure: 1.5 Evolution of waste management in USA

### 1.5 A brief history on the waste regulation in Oklahoma perspective:

To report these rising problems in Oklahoma, the Administration has passed several environmental laws to ensure a robust agenda for both proper management of today's trashes and cleanup of historical uncleanness. These laws were progressed as mentioned in the figure below.

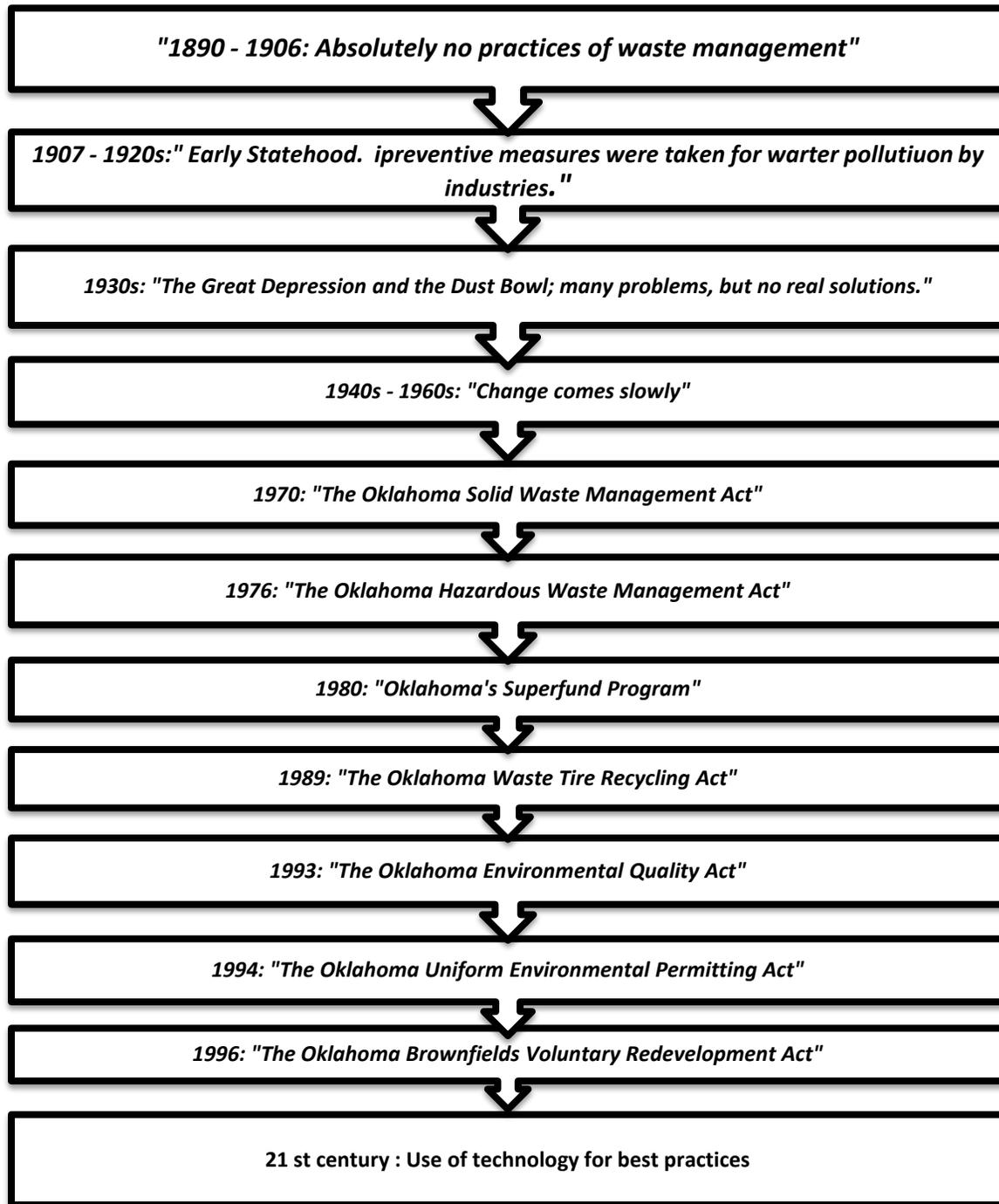


Figure: 1.6 Evolution of waste management in **Oklahoma**

Man has struggled with this serious threat of management of waste for many centuries. For more than 200 years, commencement in colonial America, waste was deliberated more a trouble rather than something demanding undeviating attention. This initiated to gradually vary during late1800s and early 1900s when, America's hasty development and also the jerk of the American industrial age, governments that are local began to report the difficulty. Nevertheless, important governmental envelopment at any level is secured until the last half of the 20th

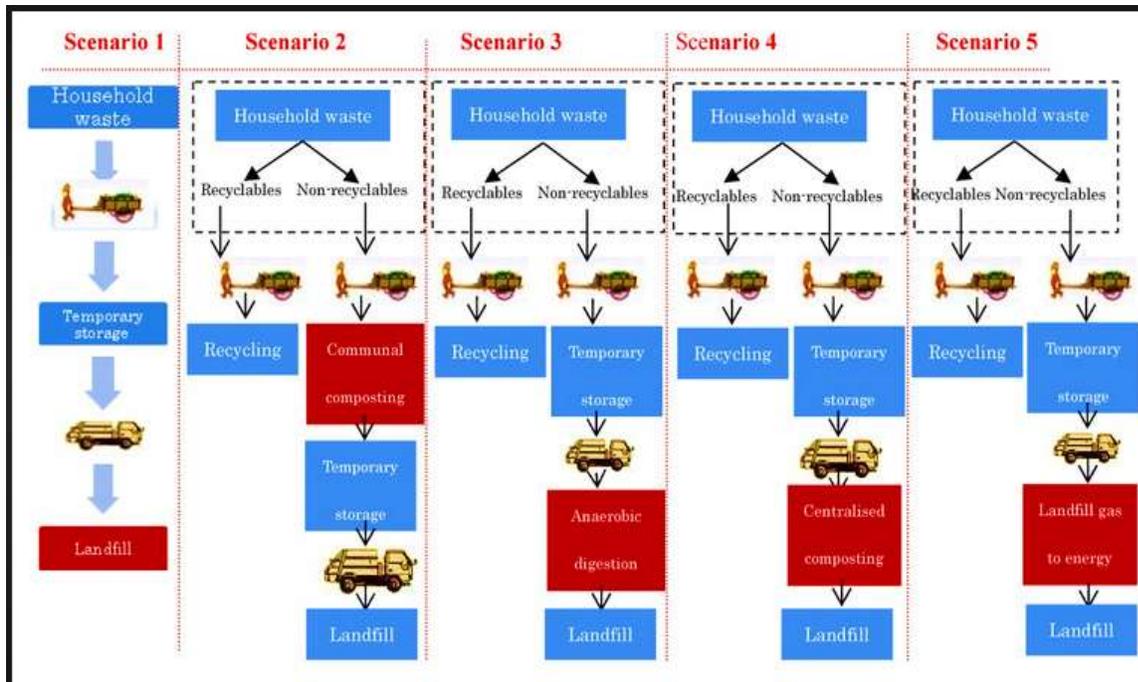
Century when the management of waste, focus shifted from “what couldn't be done with waste to what is the best way to manage the waste that is generated.”

All the above-discussed evolutions are describing about the management of waste processes of developed county scenario taking an example of the USA and the Oklahoma.

Now Indian scenario of management of waste and its evolution will be discussed in brief on the gap that is found in the literature review that is financing management of waste.

**1.6 A brief history of management of waste in India:**

Among the measures that are available and methods that are essential in addressing India’s imminent management of waste upheaval, the most dexterous will be variations at the nationwide policy and development stage. It is very well recognized amongst the minor but rising management of waste sector that urban India will triumph rock bottommost owing to ineffective management of waste. Unfortunately, they consider such a crunch is essential to fetch strategy/policy changes, as they usually incline to occur only after the loss has been incurred. This approach is tragic because it plugs a deficiency of or ineffective effort from the segment to alter policy, and also the level of India’s preparedness and planning. 32,000 will be further added to the cities of India regularly, till 2021 unceasingly. This figure remains as a caution to the currently existing infrastructure for urban Indians which are just 25,000 new Indians from cities during the last decade. The measure of development in India as well as around the globe is unparalleled with global significances to Earth’s energy resources, its natural balanceand limited material. Different scenarios during different times are given in the figure below:



**Figure: 1.7 Different scenarios of waste management in India**  
**Source: Adopted from indiansolidwaste.com solid waste management**

Increment in access to cleanliness infrastructure normally lags behind the urbanization rate by 33% around the globe; nevertheless, the lack of impromptu piecemeal responses and planning to the management of waste subjects witnessed in India might show a broader gap. This results in longer time waiting for the urban area people to implement the waste management infrastructure. Now according to the 2016 statistics the waste generation is as given below:



Figure: 1.8 Amount of waste generated in India according to 2016 statistics

Source: Gone to waste: How India is drowning in garbage India, Feb 09, 2016, Hindustan Times

### 1.6.1 Are the cities flexible to change?

For a short period, municipal organizations tied their hands and will be unable to convey resolutions directly. They confront the mission of comprehending management of waste amenities inside cities though no one of their inhabitants need them close to their houses. Administrators of Hyderabad's municipal organization have been leading meetings with residents for more than 8 years currently for a novel landfill site, to no benefit. Despite the escalating pressure, utmost corporations will be unable to close the dumping sites that they are using now. This may not be the best news for which residents could be awaiting; nevertheless, it is significant that administrators, legislators and municipal officials be clear about it.

Absence of prevailing alternatives, other than averting waste slightly by rising informal recycling sector's role, which is informal, closing existing landfills, implies finding new sites for land filling. Discovering new landfills in and around current cities is practically challenging because of the past data of the operations of dumpsites and conservation in India and the "Not in My Backyard (NIMBY) phenomenon." Nevertheless, the corporations should take actions to lessen open burning and landfill fires and device pollution control measures.

Municipal officials found that many a times they receive more waste than the capacity of the waste treatment sites that they have designed for. Most of the municipal administrators are of the logic that an enchanted answer is right in front of them that converts all of urban area's waste into gas or fuel oil, or even into recycled products. While such alteration is technically conceivable with infinite energy and 1 sources of finance, that is not authentic. In spite of their incapability to decorously manage generated wastes, most of the municipal officers equate waste and "wealth"

when loomed by other private partners. Consequently, a considerable percentage of officials presume royalty from investments of private devoid of distributing risk of business.

### **1.7 Is Technology the main problem or financing, for waste management?**

According to the studies that were done recently the main hurdle for the management of waste is financing it rather than the technology implementation. This problem is mainly for the low and middle level income countries like India. It is also found that the gate fee for this waste management is bare minimum so it is necessary to explore other channels like taxes for the maintenance. This will help to fund the maintenance of waste in the municipalities. Indian government has allocated \$1.11 million for this management of solid waste in cities which generates around 0.18 million tons of waste. It is a programme initiated as a part of Swachh Bharath Abhiyan started during 2015. Other than direct financing from state and central governments, some cess and superior taxes have been employed to fund these schemes. During the FY 2015-16 national budget allocations, the Indian government empowered the facility to implement a strategy using taxes that is a tax of up to 2% on certain or all services to finance the "Clean India" initiative. On November 15th 2015, on all taxable services a tax of 0.5% was officially alerted.

### **1.8 Conclusion:**

According to the studies that were done recently it was found that the main hurdle for the management of waste is financing it rather than the technology implementation. This problem is mainly for the low and middle level income countries like India. It is also found that the gate fee for this waste management is bare minimum so it is necessary to explore other channels like taxes for the maintenance. This will help to fund the maintenance of waste in the municipalities.