**WASTE MANAGEMENT IN BUILDINGS:**

**Executive summary:**

Though this is a very usual topic, this area always seems interesting as there are multiple ways to deal with waste. This research paper is on waste management in the buildings. USA being the largest producers of waste, there are many kinds of waste being generated , it could be hazardous waste, companies waste, municipal waste. This paper is more on the municipal waste in Utah.

Every standard building has waste bins dedicated to every house in the apartment. There is lot of waste generated by building on everyday bases and there are no signs of slowing down. There are number of factors, few could be the growth in the population , lifestyle , urbanization. Some small managements in place where one is living in could make lot of difference in those landfills filling up and recycled.

To reduce the wastage , there could be sensors placed on the trash bins and based on the weight of the trash bin we could come to conclusion on which house has produced less waste and reward them with cash price or discounted utility bill on monthly bases. There are many waste management methods, but this could be beneficial for the customers as well as the society and in-turn to the environment. These small steps add great value.

Data could be gathered from each house for months and see the trend in the waste management and stored in the cloud. There is no as such risk involved in this except that some people may not be that enthusiastic to be part of such initiatives.

Big data would help in analyzing as it has all the available tools to do so. This can help predicting the weights of the trash bins everyday and calculating the monthly trash weight of each apartment and can also predict how much overall the building would be generating the waste monthly. To lure up the competition the societies can further have competition with other society’s situated by locality.

Based on the data collected per year from each of the societies , the government could pitch in to give some of the benefits so that the zeal would still be pertaining in the minds of people and society with the benefits thrown their way.

**Problem identification**

The objective is reduced waste in building which turns help in waste management cost and the environment. Waste disposal has been a serious issue and we have been dealing with these years together now. Community engagement has been a challenge but coming up with creative idea by the societies could help rectify the solution to some extent.

Good building have good trashing system, to start with the sensors can be deployed on these trash bins which is collected by the valet daily and then the data collected from each bin could be recorded daily and kept track of.

The house which has a smaller number of garbage weight can be rewarded with cash price or waiving off the utility bill on monthly basis.

Below is the municipal waste disposal of Utah from the Utah gov which has increased significantly.

Chart, line chart

Description automatically generated

The landfills are filling up and there are still tons of waste to be recycled. As per the Utah government data in 2006 there were 35 landfills permitted to receive MSW for disposal.

Community initiative is a small step towards the waste management and use the data collected from each apartment to keep tracking of the waste produced by a single building and can also use the data for predicting the waste generated in the future as well with data divided as training and test.

This historical data can further be used by the companies for further predictions.

By applying analytics, we can predict the total weight of the trash produced by the building in the years to come.

Below is the value as value is the key element asked by owners or the stakeholders

Data

WiFi , Sensor data,

Analytics



Insights

Weight estimations , cost estimations



Value

Reduced cost , reduced garbage per society, environment friendly, less use of landfill space and transport cost

There are problems within the trash that are collected that is segregation of trash as wet, dry and plastic . There were initiatives on this front as well nut failed due to lack of people not maintaining the trash segregation rules and mixing up dry waste and plastic. And I think, we ourselves are good example for this as we tend to mix up the trash knowingly or unknowingly.

**Your solution – data science proposal :**

**Goals:**

The goal here is to reduce the waste in the societies which in-turn will reduce the waste cost management and so will it be helpful for the environment.

This social problem can be solved with very simple sorting of wastage that is through weight of your garbage generated per day. The data would be collected everyday and stored. That data that is present in the cloud can be imported and can be further analyzed.

The data collected is very useful in analyzing lot of prediction or visualizing the wastage.

For example:

* The data could be visualized on per houses with garbage collected
* Visualization of wasted overall by apartment monthly
* Prediction of wastage next month or prediction of waste yearly by separating the data into training and testing data

**Actions**:

The action that can be taken is , when we have the predictions or visualization , we can reward the person who produces less garbage by providing coupons or cash or reduced utility bill.

Also, we will be able to check on the flats are producing the maximum wastage and could let them know to reduce the same if the same continues for 2-3 months.

This initiative will bring awareness amongst the people, and they will always tend be careful and reduce the waste as much as possible. This would not only benefit the customers personally, but it also helps the environment and the society.

**Data**:

The data would be collected flat wise, we need to be processing the data to depict the wastage , analyze it and identify intervention.

We would be able to identify the dataset, aggregate it and present it as well for making the decisions.

The Dataset includes the following entries:

* Garbage weight
* Customer id
* Customer name
* Apartment number
* Month

Table

Description automatically generated

File – garbage.xlsx

The below data has been visualized with house no vs garbage weight apartment wise. And here we see that apt 2 has the lowest weight of garbage for a particular month.

Chart, bar chart

Description automatically generated

For the above data, below is the mean , median , outliers and quartile regions based on the garbage weight.

Chart, box and whisker chart

Description automatically generated

# Visualization of wastage monthly vs the garbage wastage of the entire building:

Table

Description automatically generated

File - Garbage Collection\_By Month.xlsx

Chart, bar chart

Description automatically generated

The above graph depicts the wastage produced by the building monthly and we can calculate the cost estimated for this waste disposal and management.

#The below two visualizations are done in tableau which shows each apartments monthly garbage collection and which apartment has the highest and lowest number of waste disposal.

Chart, bar chart

Description automatically generated

Table

Description automatically generated



These are the 2 ipynb files for reference.

**Validation:**

The data can be exported csv,xml or json . Once the data is extracted, we can use any tools to perform analytics.

Here the target variable is garbage weight which is a supervised learning and hence we could be using the models like linear regression , KNN , decision tree, naïve baye’s and design the ROC curves for the same as well .

KNN algorithm can be use for identifying the garbage weight of each house, monthly yearly or daily. This prediction will help in estimating the cost incurred for the disposal of these wastes and how each house or the building would be generated yearly or monthly can also be predicted, and collective actions could also be taken on the same.

**Tools:**

The technologies that can be used here is python or R-programming , we can use specific visualization tool like tableau or jupyter labs as well works the best on these kinds of data.

Visualization is always better as any normal person can understand what exactly is going on. Its very easy to predict.

The data must be imported to any of these tools for performing all the analytics or visualization

**Risks:**

The risk involved here is the data privacy as it involves customer name and the apartment number , the data must be kept secure and be only accessible to the building and no one else. Even if the information must be shared to a third party , consent of the apartment members must be taken before sharing.

There are possibilities of the sensor not working, to tackle these kinds of scenario , it always best to keep a regular check on them may be monthly or quarterly for accurate results.

There is always scope for future development and there could be a mechanism where there would be inhouse segregation and recycle and use as a fuel.

These are part of the future enhancement for more better waste management without the intervention of human.

Being a responsible citizen will help build safe environment for everyone. Its individuals responsible for creating better tomorrow . These fancy initiatives if taken by every apartment should save lot of resources.

**REFERENCES**:

<https://documents.deq.utah.gov/legacy/programs/waste-management-radiation-control/solid-waste/docs/2008/05May/VOL_QAPP.PDF>

[2015 Data Science Salary Survey (sdsu.edu)](http://www.eli.sdsu.edu/courses/fall16/cs696/2015-data-science-salary-survey.pdf)

file:///C:/Users/anush/Downloads/BIG\_DATA\_ANALYTICS\_FOR\_EFFICIENT\_WASTE\_M.pdf

https://www.statista.com/topics/4983/waste-generation-worldwide/#topicHeader\_\_wrapper

<https://documents.deq.utah.gov/waste-management-and-radiation-control/solid-waste/DSHW-2019-002196.pdf>

[Facts and Figures about Materials, Waste and Recycling | US EPA](https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling)

[Where You Live | US EPA](https://www.epa.gov/trinationalanalysis/where-you-live)

[BIG DATA ANALYTICS FOR EFFICIENT WASTE MANAGEMENT | eSAT Journals - Academia.edu](https://www.academia.edu/30438159/BIG_DATA_ANALYTICS_FOR_EFFICIENT_WASTE_MANAGEMENT)

[Societies in Smart Cities: Lessons Learned from Waste Management | Published in AIB Insights](https://insights.aib.world/article/19504-societies-in-smart-cities-lessons-learned-from-waste-management)

[Solid Waste Facilities Permits and Permitting - Utah Department of Environmental Quality](https://deq.utah.gov/waste-management-and-radiation-control/solid-waste-facilities-permits-and-permitting)

[Municipal Waste – Greater Salt Lake Municipal Services District (utah.gov)](https://msd.utah.gov/notices/municipal-waste/)