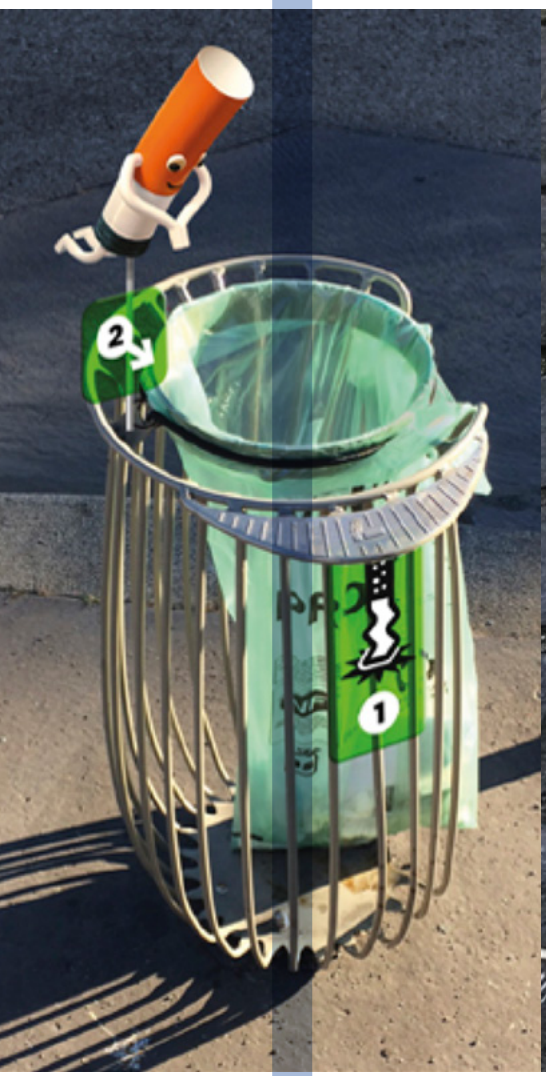
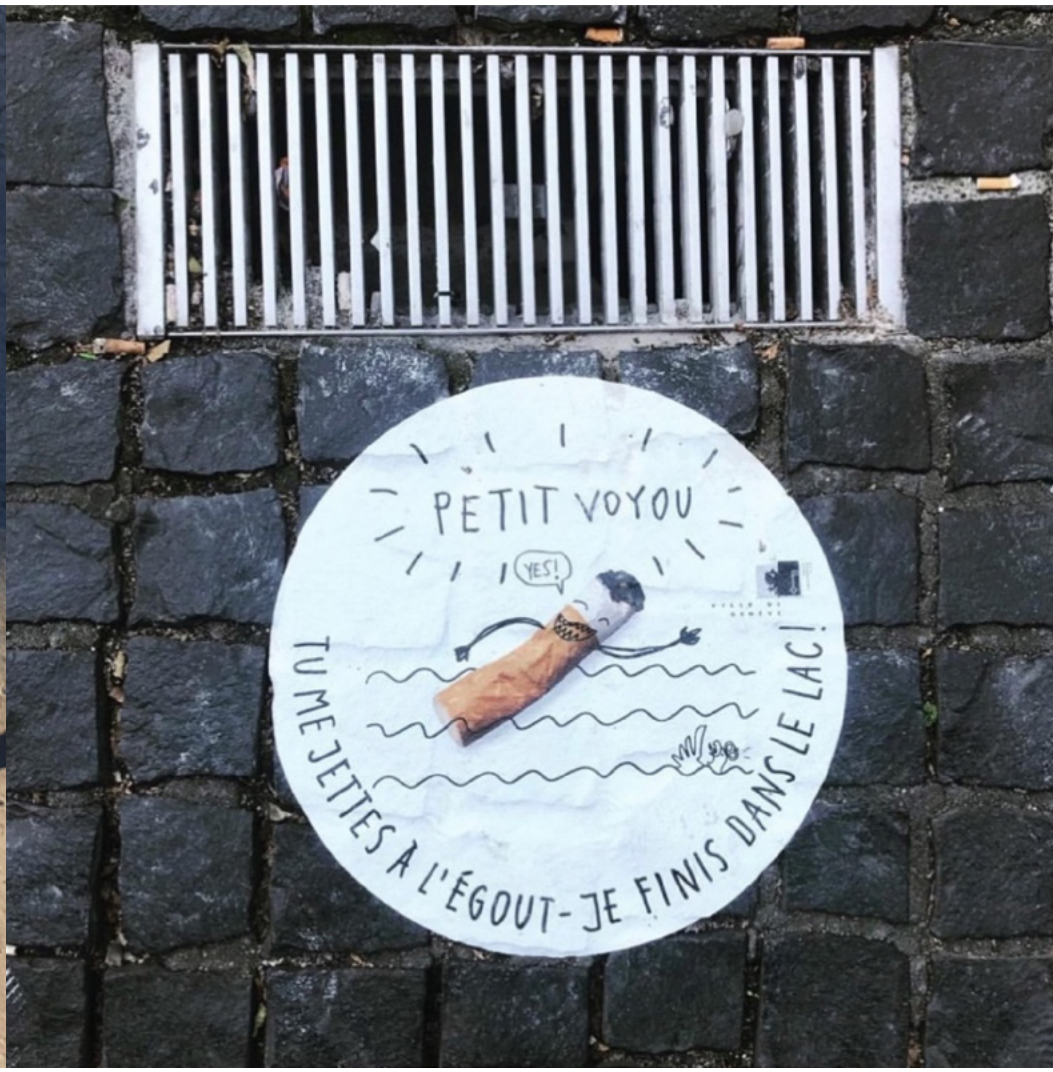
A GUIDE TO BEST PRACTICES TOWARDS CLEANER CITIES.





CORTEX IA
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1. NEW APPROACHES TO URBAN CLEANLINESS MANAGEMENT

Urban cleanliness is an essential component for the attractiveness and safety of a city, and for the quality of life of its inhabitants. It also has a significant role to play in the city's sustainability. Street litter can end up in the natural environment. In addition, cleaning uses energy, water and emits noise, dust and CO_2. Keeping a city clean is a challenge for modern cities, as population and mobility increase, behaviors change, and public budgets are under scrutiny.

The mission of municipal cleaning services is to ensure a clean city and to preserve the environment. Most municipal cleaning services manage their operations with weekly routine schedules. Some of them have introduced the measurement of cleanliness and the development of a continuous improvement process. What cannot be measured, cannot be improved.

In this report, we will present how urban cleanliness, resources and environmental footprint can be optimized with a data driven approach. We will propose metrics and discuss best practices from exemplary towns and from dedicated field experiments conducted in Cortexia's "Clean City Lab" in Geneva[1]. The findings and improvement measures from these experiments are summarised at the end of this report.

It's therefore intended to provide a guide of best practices, for which the impact has been objectively demonstrated in the field, which can be used by municipalities or Producer Responsibility Organisations seeking to optimize public cleaning services. For further details, the reader is invited to read the publicly available "Clean City Lab" articles.

2. METRICS

A quality management approach has been developed to improve urban cleanliness, save resources and preserve the environment, for which we propose the following quantitative measurements:

- **Cleanliness level**
  Depending on the goal, urban cleanliness may be assessed with population surveys, litter monitoring (ie counting) or assessment of a cleanliness grade. Various methodologies have been defined at national level and implemented at municipal level. Litter monitoring and cleanliness grading are relevant respectively for:

  - Environmental monitoring, for example to assess the impact of anti-littering campaigns or assess the progress towards plastic litter reduction targets.

  - Urban cleanliness management, for instance to measure the cleaning department's efficiency and quality of service. We use the "Clean City Index", which is a methodology developed by the city of Zurich in 2000. This index is representative of the users' cleanliness perception of a street on a scale from 0 (dirty) to 5 (clean). It is public, in use in Switzerland, Germany and Austria, and allows to identify the type of soiling.

- **Resources (costs)**
  The most accurate way to evaluate the efficient use of resources for municipal cleaning services is to assess the cleaning costs. Municipal cleaning cost accounting would be the most accurate approach, but it can rarely be used because cities do not usually report on these cleaning costs separately. Alternatively, estimations based on people and machine hourly rates (bottom-up approach) can give good first estimates.

  Between cities of a same country, per capita cleaning costs vary from a factor 1 to 4, without being correlated to the level of cleanliness[2]. This means that the use of more resources do not necessarily lead to a cleaner city. We rather believe that efficiency gains are achievable by sharing best practices among cities and municipalities.

- **Environmental impact**
  We have identified and characterized three categories of environmental impacts: litter leakage to natural environments, use of water for cleaning, as well as CO_2 emissions and air pollution from machinery:

  - Public litter which is not collected may end up in the environment, mostly through water ways. This concerns mainly single use plastic items, such as cigarette butts and plastic packaging of single use products. Geneva's cleaning services estimated that daily 1 to 2.5 cigarette butts are littered per capita. Cigarette butts are not easy to collect mechanically, for instance when they are located under cars,

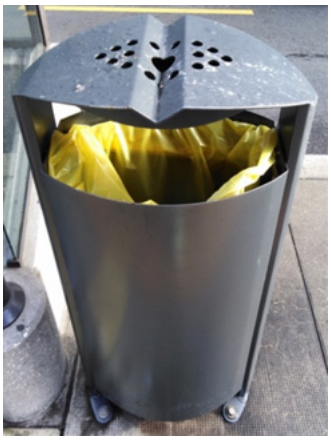
road cracks, between paving stones or within tree grates. We measured that 18% may remain after the sweeper cleaning. Some of these may be carried to water drains during heavy rains. By placing filters in water drains on a street in Geneva, such as in gully openings, we have measured that approximately 2% of the cigarette butts present on the street will leak into the water ways.

- On the other hand, the cleaning operations have their own environmental impacts. Some cities use street washing machines, which consume considerable amounts of water (predominantly drinking water). A direct consequence of this washing is that the water flushes litter down the drains to water ways. A city that cleans without washing will use 30 times less water per capita.

- Finally, the street sweepers work mainly with diesel engines and emit yearly around 200 tons of CO_2 per 100'000 inhabitants, along with other air pollutants.

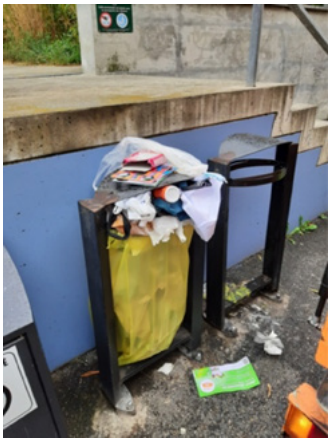
3. PREVENTION: REDUCTION OF LITTERING

Reducing littering - soiling less - is a sustainable approach to get a cleaner city by tackling the issue at its source. Adequate urban waste furniture and consumer targeted communication play a key role.

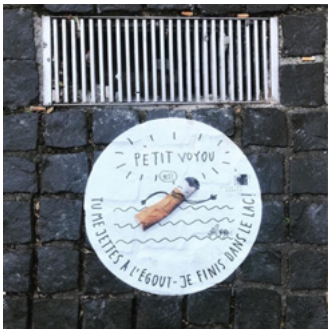


Public trash bins allow people to dispose their waste correctly. Whereas cities often focus on the quantity of bins to be disposed, their effective eness - the amount of litter which is found on the street after a given time – is even more important. This effectiveness is greatly dependent of the bins aspect and position. Well placed and visible bins, such as colored or signaled bins, are more likely to be used. Working on behavior through advertisement and nudges[3] is effective and may reduce littering by 25% to 50%[4].

Special attention should be paid to hotspots "attracting" litter, such as domestic waste collection points. Overflowing or dirty bins may cause users to become more negligent and litter more. Waste collection points, if not managed properly, will also induce more littering.



Increasing the effectiveness of public bins to be used for cigarette butt disposal is particularly critical, as in one behavioral study it was observed that 75% of littering acts near public bins are done by smokers[5], of which many are not comfortable using the bins. Ashtrays or stubbing plates should be easily recognized. The stubbing plate and its way of working must be instantly understood by the user (especially if it is necessary to extinguish and then throw the cigarette butt into the alongside located bin bag). By changing the design of the public trash bins, making the ashtray evident and improving the cigarette butt collection, the city of Geneva halved the amount of litter around the bins.



The management of public bin and ashtray infrastructure is also subject to optimization. The mean value of bin filling rate (measured by reporting the bin filling rate 0%, 25%, 50%, 75% or 100% when changing the waste bag with a smartphone app') at Geneva's Clean City Lab is 40%, other cities have reported similar rates. We estimate there is generally a potential to reduce the number of bins by 20% to 50% by a sensible and global approach considering the bin design, size, function's efficiency, the integration in the urban architecture, the bin's ergonomics and maintainability and their improved signage.

Cigarette butts also get littered directly in stormwater drains and thereby are likely to end-up in the water ways. Dedicated signage addressed to the public, for instance directly on the drain (see picture right from Geneva's awareness campaign "Petit Voyou"), can help to prevent such subsequent water pollution.

4. REMEDIATION: IMPROVING CLEANING EFFICIENCY

Cleaning vehicles are typically engaged on a routine schedule and will run regardless of how clean or how dirty the street is. Measuring the level of cleanliness allows to clean only when and where it is necessary and to thereby increase the efficiency of services.

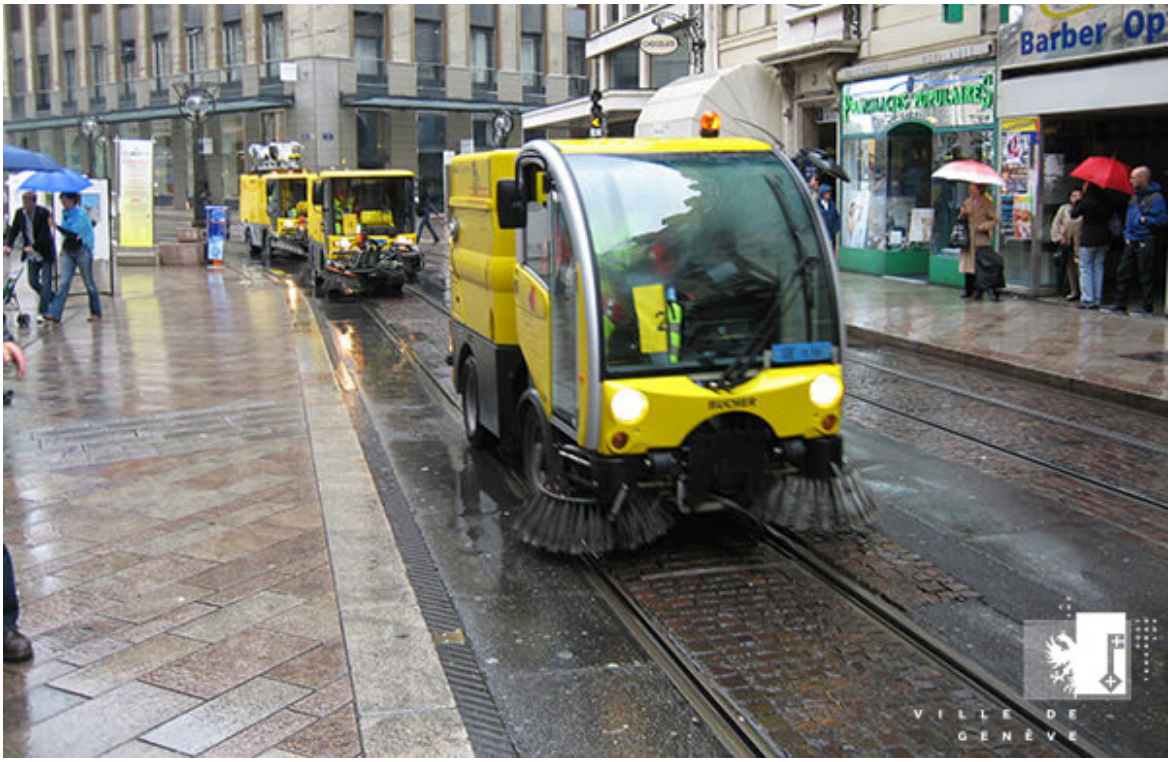
In the Clean City Lab district, the Geneva Cleaning Services defined their own target cleanliness level they wanted to ensure. The district is divided in areas which are cleaned according to a routine weekly schedule. An initial cleanliness measurement identified areas where cleanliness was above target (i.e. cleaner than their target) and areas below target. Cleaning in the areas above target was reduced in order to clean more frequently the dirty areas. The result was a higher and more uniform cleanliness, matching the target, over the entire district.

In a second step, the sweepers' routes were rearranged in each area according to the level of cleanliness and the time needed to clean the streets. This resulted in the savings of one in three street sweepers and 20% of machine hours, yet ensuring the targeted cleanliness level was attained.

In the down-town district of the city of Utrecht (Netherlands), the cleanliness level was unevenly balanced among different areas. Citizens were regularly complaining about cleanliness issues in the shopping area. The entire down-town district was cleaned by two street sweepers and ten workers. The municipal cleaning services adapted Geneva's approach, as described above, by reorganizing the size of the cleaning areas: the areas which had been initially too clean were enlarged (more surface to clean with the same resources), the contrary for the areas which had been too dirty. Cleaning frequencies and routes were also adjusted locally. The result was a more uniform and higher level of cleanliness, within the expected quality level to the satisfaction of shop owners and citizens. Four out of ten workers could be freed up for other tasks, such as littering prevention.

The city of Basel defined the necessary number of street sweepers to achieve the target level of cleanliness based on the vehicle utilization rates and cleanliness measurements. They put the reserve vehicles at the disposal of a common pool and reduced the total number of sweepers by 15%. The reduction in the number of equipment helped to offset the transition cost to more expensive electrical vehicles. This is how Basel will fulfill its 95% zero carbon cleaning by 2025.

These real case examples demonstrate a simple method to achieve a higher and more uniform level of cleanliness with less resources (number of machines, machines hours or workers) and less CO_2 emissions. A target level of cleanliness is defined, and the cleaning resources are adapted to reach this level, reducing the cleaning effort in the areas above target and using them for the too dirty areas. Potential resource savings are around 10% to 20%.



5. TOOLBOX

This guide proposes practical solutions to improve urban cleanliness, reduce littering and litter. The solutions use cleaning and prevention resources in more efficient ways, which make them attractive for municipal cleaning services. The most commonly found situations and their mitigations are shown in the table below.

FINDINGS	MITIGATION	FURTHER INFO
• Unsatisfactory level of urban cleanliness • Non uniform cleanliness between areas • High number of complaints addressed directly to the municipality or via social media • Insufficient resources to clean the city	Improve cleaning efficiency by redesigning cleaning areas, routes and planning according to the measured level of cleanliness. This planning can be seasonal.	MORE EFFICIENT CITY CLEANING
• Too much litter on the ground	Improve trash bin effectiveness with more visible, engaging and well-maintained bins; Place visible bins in hot spots, reduce the number of bins in other areas; Enforce trash bin efficiency with appropriate signage and nudges.	STREET LITTER BIN, AN UNEXPLORED POTENTIAL
• Too many cigarette butts among litter on the ground	Make ashtray function evident (extinguish and dispose), design the ashtray to collect the cigarette butts without litter.	TOWARDS CITIES FREE OF CIGARETTE BUTT LITTER
• Direct littering into the stormwater drains	Raise awareness with dedicated signage on stormwater drains.	TOWARDS CITIES FREE OF CIGARETTE BUTT LITTER

6. CONCLUSION: SOLUTIONS FOR SUSTAINABLE IMPROVEMENT

There are many initiatives to address urban litter. There are fewer where effectiveness and efficiency have been measured quantitatively in an objective manner. Such best practices which have been proven effective, as the ones described in this paper, should be shared and replicated to reach economy of scale and improve their impact. Only a broad approach, borne by all stakeholders, will solve the issue.

This is why, in our opinion, it is of utmost importance to measure quantitatively and objectively the effectiveness and efficiency of each action. This effectiveness should be measured in terms of impact (reduction in the quantity of litter or improvement of the cleanliness index), costs and scalability (easiness to use, efficiency gains, acceptability, etc.).

Achieving environmental commitments for a company, such as reducing the litter from its products, or targets for cleaner and more sustainable cities, require a structured approach based on shared responsibility, cooperation with stakeholders, and data-based measures.

This is especially true for cities. In Europe, cities account for 75% of the population. Urban littering has a significant impact on the environment. 300 billion cigarette butts are littered annually in Europe, 12 billion of which end up in the oceans[6]. Cleaning uses resources and emits CO_2.

The municipal public cleaning services have a central role to play. They need a structured approach, inspired from quality management approaches for continuous improvement such as the Plan-Do-Check-Act or the more recent operational excellence, to focus on the most effective actions, improve them in a continuous loop and achieve a clean and sustainable environment.

ACKNOWLEDGEMENTS

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1. The Geneva “Clean City Lab” was a one-year collaboration project between the City of Geneva and Cortexia, where a data driven methodology was developed and tested and field results measured in one of Geneva’s urban district.
2. See “COST OF URBAN CLEANLINESS: IMPRESSIVE DIFFERENCES BETWEEN CITIES” for Spain, France and Switzerland
3. The nudge is a technique for changing behaviors through incentives, without constraint or obligation. Nudge acts on the irrational part of the decision, often in a playful way.
4. https://www.vku.de/fileadmin/user_upload/Verbandsseite/Publikationen/2020/VKU_Broschuere-Littering_Info93.pdf
5. http://avpu.fr/wp-content/uploads/2018/11/Paris-ETUDE-COMPORTEMENTALE-CORBEILLES_NUDGES_présentation-pour-rencontres-AVPU_revu-STPP_2018-11-20-2.pdf
6. Lionel Pourchier, ‘Fate of cigarette butts in marine environments’, Master Thesis M2 Marres Université Côte d’Azur, 2020

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