HUBGRADE SMART MONITORING CENTERS:
measuring resource consumption and moving towards a circular economy

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KEYWORDS

- RESOURCE SAVINGS
- CIRCULAR ECONOMY
- URBAN METABOLISM
- DIGITAL REVOLUTION
- REAL-TIME
- CHANGE MANAGEMENT
- MACHINE-LEARNING
- ARTIFICIAL INTELLIGENCE
- INDUSTRY 4.0
- DIGITAL TRANSFORMATION
- OPERATIONAL PERFORMANCE

How can cities, businesses and industries boost growth in the face of resource scarcity? Firstly, they can start by measuring their consumption in order to manage it more effectively. Then, all of us can to move away from a linear model of consumption. We can accelerate this transition today, thanks to IoT[1], the digital revolution.
At Veolia, we are the first to monitor and to optimize water, energy and material flows in real-time. We are developing smart monitoring centers called Hubgrade relying on connected products and artificial intelligence. With these centers, we are creating new jobs and business opportunities to save resources. Hubgrade boosts energy efficiency and water conservation measures. It optimizes material recovery and maximizes the use of renewable energy. However, this is only possible, with the focus on the human factor.

1 IoT – Internet of Things

INTRODUCTION

Hubgrade is the name of Veolia's smart monitoring centers for water, energy and waste management. In these centers, Veolia's analysts leverage real-time data to optimize resource consumption of municipal, commercial and industrial clients. This innovation relies on a dedicated organization, disruptive digital tools and new business models.

Hubgrade is a tremendous opportunity to introduce a cultural change in our organization. We can revolutionize the way we operate and become more efficient. At the same time, we are offering new services and an enhanced customer experience to our clients.

We can equip each of these centers to manage data from a multitude of facilities: from municipal water networks to waste collection systems, to buildings, to industrial sites, to district energy systems and more. Today, we have 15 Hubgrades already accelerating the transition towards a Circular Economy. They guarantee us that no precious resources are wasted.

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1. A CHALLENGE AND AN OPPORTUNITY

1.1 BOOSTING ECONOMIC GROWTH WHILE FACING RESOURCE SCARCITY

Global urbanization is increasing and cities are putting the planet under enormous pressure. Since the 1970s, humanity has been consuming more natural resources than the planet can provide and renew in a year.

Today, humanity actually needs one and a half planets to be sustainable. By 2050, at current rates, we would need almost three planets. Our demand for water, energy, food and goods is rapidly increasing. The Take-Make-Dispose model of the past has also led to extreme pollution, price volatility and biodiversity collapse. Besides the impact on climate change an on the environment, this causes evident effects on the economy and society. The challenge now is to decouple economic growth from resource consumption.

We need to move towards a Circular Economy where nothing is wasted. In practice, this means not only preserving energy and water, while minimizing waste. We also need to improve energy efficiency, increase recycling and boost renewable energies. Moreover, we need business opportunities to accelerate this change.

'Doing more with less' is conceptually simple but quantifying resource efficiency is more complex in practice.

1.2 SMART URBAN METABOLISM: HIGHLIGHTING OPPORTUNITIES TO SAVE RESOURCES IN REAL-TIME

The new generation of data solutions allows us a deeper study of urban metabolism. Urban metabolism is a model representing the transformation of natural resources in products and services. This model quantifies economic value of what we use and what we waste.

Now it is possible to have a higher temporal resolution of consumption. This enables us to build smart urban metabolism
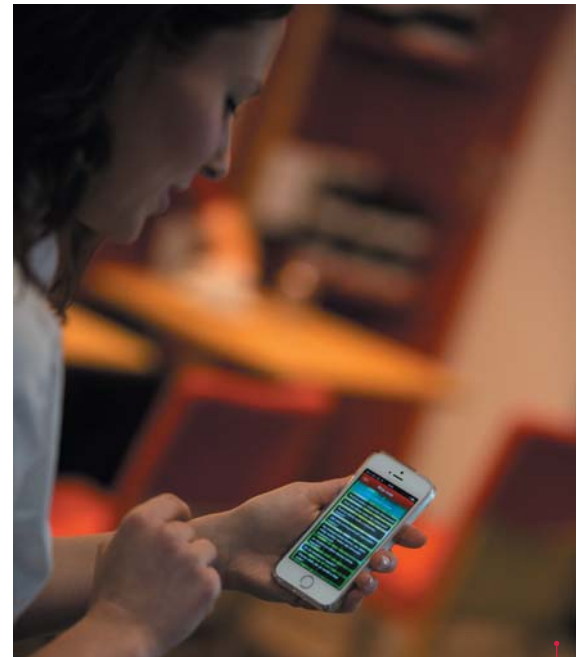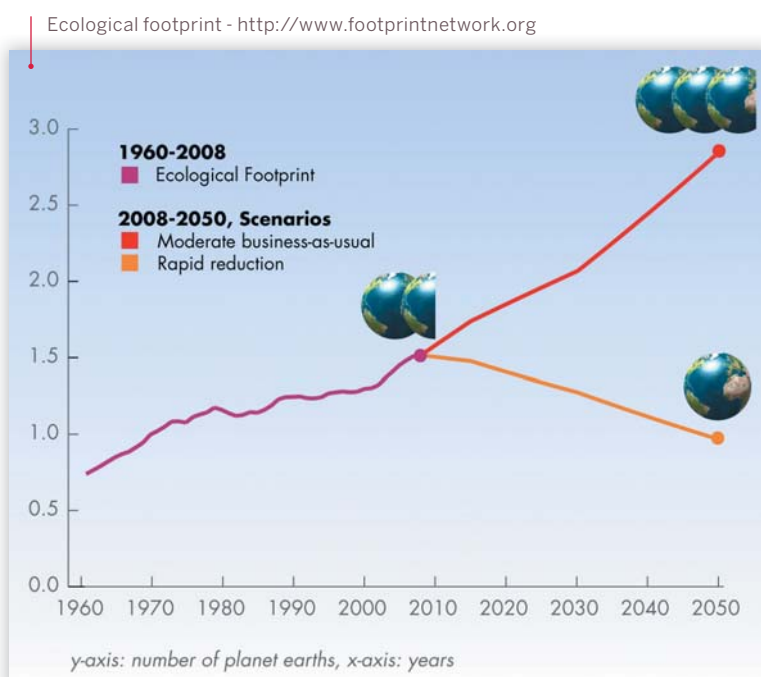

End-user

models, using real-time data. Such virtual models represent the interconnectivity between different subsystems, which can be urban infrastructures, offices, schools, hospitals, industries and even households.

So, what are the benefits of smart urban metabolism models? These models make it is easier to replicate sustainable solutions to other subsystems. This happens when these subsystems have similar challenges. For example, an urban infrastructure needs to become more resilient, livable or even inclusive. The same applies to buildings and to industries that must become greener and more resource efficient.

The resources we are wasting will end up being either emissions or discharges to land or to water sources. In order to avoid such waste, a holistic approach on resource saving is required. Smart urban metabolism offers exactly that. It highlights the value of a subsystem's waste to other economic sectors. This facilitates a business transaction so that waste can be reused, recovered or recycled by other subsystems. Emissions and discharges also cost money and become evident opportunities to save.

These predictive models to analyze resource consumption are something very concrete to us at Veolia. We convert these models into performance contracts with our clients, with guaranteed savings. It may seem that we have always operated contracts like these. So what has changed?

Ecological footprint - http://www.footprintnetwork.org

1960-2008
■ Ecological Footprint

2008-2050, Scenarios
■ Moderate business-as-usual
■ Rapid reduction

y-axis: number of planet earths, x-axis: years

Now, we can commit to save significantly more. We understand the value chain of resources outside our traditional operations. Sensors, smart products and other digital technologies extend our capabilities. Besides implementing and operating efficient systems, we engage end-users to play a major role in the solution. They take responsibility to change their behaviors because they foresee the benefits for them. Through smart solutions, citizens and other end-users receive the insight they need to save more.

Veolia cannot monitor every resource flow in a city, and that is not the point. However, we do commit to improve resource efficiency for the perimeter we operate. This is why the municipality of Pudong in Shanghai has chosen Veolia to manage its water networks.

More recently in Shanghai, Veolia launched a Hubgrade for Water, Energy and Waste management. We can now offer higher level of commitments to existing customers. We can also offer these innovative services to new clients all over China. This way, they too, can save even more.

2. HUBGRADE

2.1 WHAT IS HUBGRADE?

Energy and water savings, waste minimization and recycling rates, carbon emission reduction – Veolia has always tracked these key performance indicators. Now, we can track them in real-time and from anywhere we want. However, this requires a major organizational change.

For this reason, Veolia deploys a dedicated organization, digital tools and new business models. This is how we created Hubgrade, our smart monitoring center. Through Hubgrade, Veolia is bringing operational synergies to all our water, energy and waste activities.

In Hubgrade, we combine data management with our technical expertise on the field. This results in significant risk mitigation. At the same time, we are much closer and more responsive to customers needs.

Hubgrade is a real asset for change management to boost operation performance and to offer new services.

Hubgrades: Dublin, IRELAND; Paris, Marseille, FRANCE; Brussels, BELGIUM; Bilbao, Madrid, Barcelona, SPAIN; Birmingham, UK; Milan, ITALY; Amsterdam, NETHERLANDS; Dubaï, UAE; Stockholm, SWEDEN; Budapest, HUNGARY; Shanghai, CHINA; Sydney, AUSTRALIA

Hubgrade, smart monitoring center in Paris, launched 2016

2.2 HOW DOES HUBGRADE WORK?

Clients want control over costs and consumption, so their systems are fitted with sensors. These sensors transmit data in real time to Hubgrade. Then, our analysts manage this data to identify savings. This can result into immediate action or a roadmap for improvements.

We transmit recommendations to clients and our teams, depending on the type of contract. This helps them identify and prioritize resource saving measures. From an online dashboard, clients can monitor their own indicators and compare them to benchmarks. This way, they can clearly measure their progress and see the reduction in their bills.

As a result, clients and end users become more aware of how they can make savings.

### 2.3 DEDICATED TEAM OF EXPERTS

Hubgrade relies on a team of experts that share a common goal: improving resource efficiency together with operational units on-site and customers. In order to get the full potential out of Hubgrade, Veolia developed new engineering profiles:
• **Data analyst** with expertise in energy, water and waste management
• **Auditor-coach** who ensures operations on-site follow the analysts' recommendations
• **Systems expert** setting up the right data from sensors into the software applications

The capability of the Hubgrade team relies on the ubiquity of digital technologies. Hubgrade enables Veolia to respond quickly and in a targeted manner. Whenever there is an alert reported on the systems, there can be a work order generated.

The Hubgrade team can act remotely or dispatch a team on site. If this is necessary, they schedule an intervention and dispatch it to operational units. The customer can follow up all the process in parallel through a reporting application.

These new roles ensure the implementation of change management in our traditional activities. With this team, Veolia closes the loop on the resource value chain. Thus, Hubgrade guarantees we deliver more savings.

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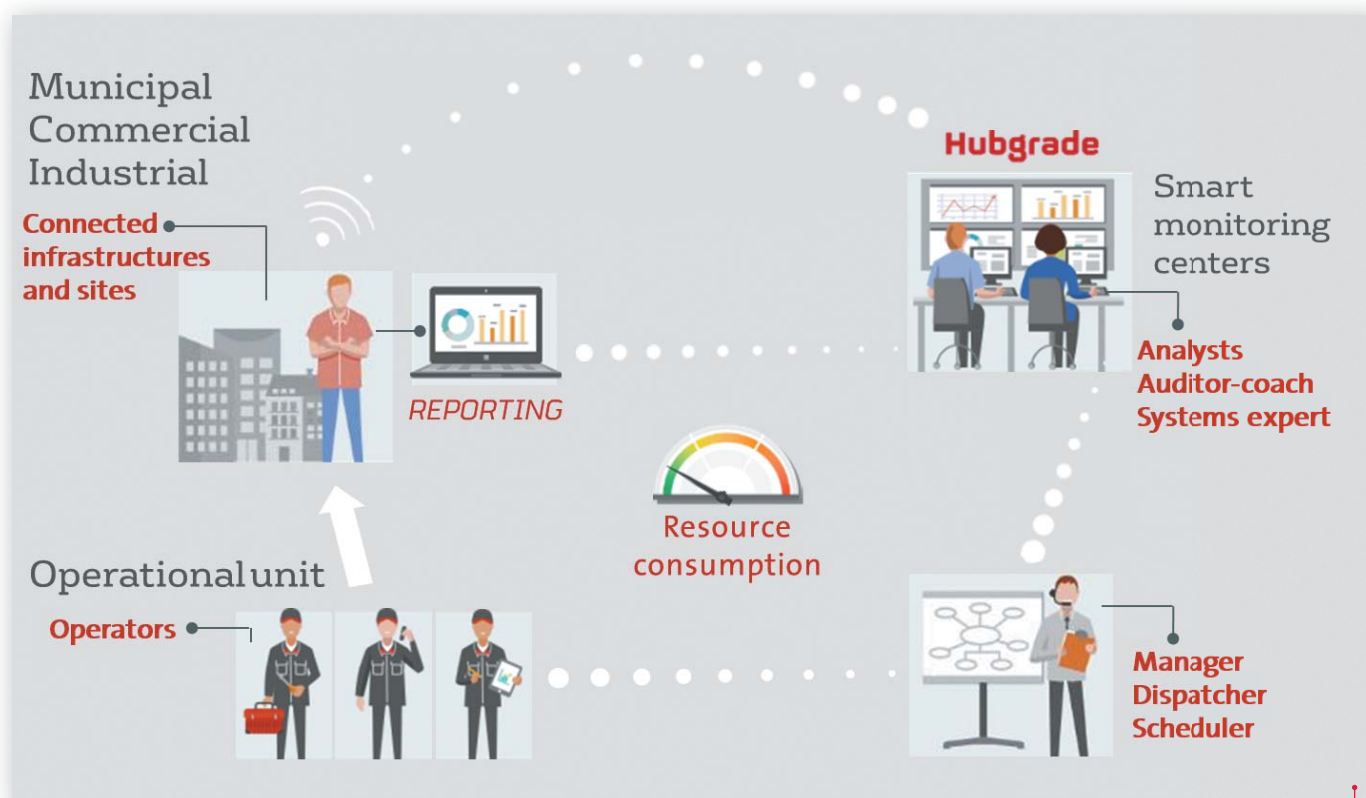
Hubgrade, a new organization to guarantee more savings

2.4 DIGITAL SOLUTIONS

Ensuring different systems communicate with each other is a major challenge in the digital transformation. At the core of Hubgrade, various systems are integrated such as EMS[1], Waste Management Platforms, Water Quality Monitoring and Control Systems, BMS[2], CMMS[3], Asset Management software, SCADA[4] systems, and even Carbon Footprint, Indoor Air Quality monitoring applications and more. These systems also cover functionalities such as financial analysis and benchmarking.

We also developed reporting dashboards to share with our analysts the most important information from digital systems. This helps them in decision-making and in communicating performance indicators to operational teams on the field. Additionally, we provide the client with an online access to reports, as well as awareness-raising information to end-users.

The way in which these systems work can be broken down into four stages:
• 1. Collection of information from sensors
• 2. Supply of information to databases
• 3. Data visualization through dashboards and reports
• 4. Reporting to operational teams, client and end-users

Hubgrade relies on statistical models, optimization algorithms, geographic information and forecasting tools. Data mining through meta-heuristic algorithms allows us to predict customer needs. We analyze correlations between consumption patterns and production profiles to identify improvements.

In addition, machine learning is making Hubgrade more powerful and autonomous. It brings new capabilities to help Veolia's clients switch to an "industry 4.0 mindset" by bringing them valuable information for the resources they need to operate throughout their entire production chain. In practice, we are not just looking at utilities anymore.

"HUBGRADE IS ALREADY A MAJOR "ONE VEOLIA" ACHIEVEMENT ."

"CREATING NEW JOBS FOR THE ROLES OF ANALYSTS, AUDITORS AND SYSTEMS EXPERTS THAT OPERATE IN HUBGRADE AND INVESTING IN THEIR CAREER DEVELOPMENT IS A MAJOR HUMAN RESOURCES ACCOMPLISHMENT OF VEOLIA."

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1 EMS – Energy Management Systems
2 BMS – Building Management Systems
3 CMMS – Computerized Maintenance Management Systems
4 SCADA – Supervisory control and data acquisition

We are analyzing the consumption at the heart of our customers' industrial process. For example, through machine-learning solutions, we can monitor the consumption of individual equipment. Moreover, we do not need meters for all of them.

We can apply this machine learning technologies to commercial buildings, too. One single high-frequency meter powered by machine-learning algorithms enables us to breakdown electric consumption per type of equipment: lighting, air conditioning, computers, appliances and others.

In the near future, with a single meter and some sensors we can even precisely measure the electricity use by each tenant. Our client will be able to send his tenants invoices for their individual consumptions without additional meters. These solutions will be cost effective enough for the complete switch from readings.

Crossing data, from customer activities and from ours, highlights the direct value we create for them. We monitor and report indoor air quality and comfort conditions in real-time. This way, customers know in transparency that quality is guaranteed, while consumption is kept to a minimum.

Through an online application, the circular economy seems more tangible. Clients know how much money they are saving. They can also check the emissions they reduced and the waste diverted from landfill.

2.5 INNOVATIVE BUSINESS MODELS

"Everything that can be digital, will be digital"[5]. This influences business models as well. We are adding a major layer of digital services on top of our core activities. Consequently, our business models have to change.

The unique value of the new digital component of our services has to be unleashed. For that, we need to integrate new business models in our offer. These are similar to the ones used in

Hubgrade in Dubai

digital businesses. Moving from a TCO[6] model to a SaaS[7] model has influenced Veolia. We offer Performance as a service on top of our core activities.

Although sustainability demands a long-term view, product lifecycles are getting shorter. Anyway, it does not alter our mission. We just need to be continuously innovating as demand varies and clients' expectations change.

The first main real-time solutions with innovative business models offered by Veolia are applicable to all our energy, water and waste management activities:
- Monitoring, analysis and optimization
- Interactive reporting
- End-user apps
- Information modeling
- Predictive maintenance and condition monitoring

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5 Deloitte, Smart Cities How rapid advances in technology are reshaping our economy and society Version 1.0, November 2015

6 TCO – Total Cost of Ownership
7 SaaS – Software as a Service

Hubgrade in Milan

"CHINA IS THE FIRST COUNTRY TO RECEIVE ALL THIS POTENTIAL WITH A HUBGRADE THAT DELIVERS ENERGY, WATER AND WASTE MANAGEMENT OPTIMIZATION TO MUNICIPAL, COMMERCIAL AND INDUSTRIAL CUSTOMERS."

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Citizens of China

We demonstrate all of these services to clients when visiting a Hubgrade. Everywhere there are Hubgrades, we offer an enhanced customer experience. Hubgrade provides all the transparency clients expect to trust expertise in data and our commitment on results.

Shared Value creation[8]
Although one can argue that artificial intelligence will eradicate jobs thus harming society, this argument remains vague. We believe innovation is the best way to create societal value. It has been through artificial intelligence that we are improving safety conditions to innumerous workers in the field. This is the case with the implementation of our waste sorting solution I-Sorter. Workers received training and new career progression opportunities. This example is a real value lever for sustainability.

Creating new jobs for the roles of analysts, auditors and systems experts that operate in Hubgrade and investing in their career development is a major human resources accomplishment of Veolia. The main idea is to combine human and digital capabilities to boost a social and economic dynamic while preserving the planet.

Small and medium IT services companies are developing the digital tools we use in Hubgrade. With these SMEs[9] we establish partnerships with a long-term view. We commit to create this value and deliver it to our clients so they can keep sharing it with local communities.

3. OVER THREE MILLION DATA POINTS BEING MONITORED BY VEOLIA

Veolia monitors over three million sensors, from which one million are smart meters. The manner to leverage data from them is far from optimal. The good news is that Veolia is deploying Hubgrades worldwide in an industrialized way. We already monitor over 300 thousand data points in our Hubgrades.

Let us now discover how it all started.

Well, we started by optimizing buildings. Human beings spend 90% of their time in buildings[10] – that is why these are the first places where we need to save resources opportunity[11]. In our globe, buildings consume around 40% of energy, 25% of water and 40% of materials[12]. Simultaneously, they account for the biggest share of greenhouse gas emissions on the planet. This represents approximately 1/3 of the whole globe. To address carbon emissions and tackle resource consumption, Europe established an energy efficiency directive in 2012.

Back then, to address the challenges of our customers, Veolia started to develop new digital solutions for energy management. With these solutions, we generated an average 15% savings in energy consumption. This is the case of Indra Systems, one of our 160 Energy Performance Contracts, optimized via a real-time monitoring center. Indra, which is the IT and Defense systems leader in Spain reduced by 15% the energy consumption of its 65 buildings, together with Veolia.

In 2014, as part of the group's reorganization, Veolia took the opportunity to extent this acquired expertise in these smart monitoring centers, to its water and waste management activities, and created Hubgrade. The first Hubgrades also optimize, in addition to buildings, the efficiency of Waste-to-Energy facilities and the electricity consumption of wastewater treatment plants.

Today, Veolia's digital solutions apply to all our activities. We use them for route optimization in waste collection. With them, we reduce leaks in water networks. We also use them to improve the efficiency of buildings, industries and more.

Hubgrade is already a major "One Veolia" achievement. It enables us to address the needs of our customers very closely.

China is the first country to receive all this potential with a Hubgrade that delivers energy, water and waste management optimization to municipal, commercial and industrial customers. Thanks to Hubgrade, customers and citizens interact with us in real-time. We can now provide them with the services and information they need so that together we can do more for a sustainable future.

8 M. Porter & M. Kramer – Harvard Business Review – January February 2011
   [Note: Creating Shared Value is not included in Corporate Social Responsibility, which is separate from profit maximization. CSV is rather a transition and expansion form the concept of CSR.]
9 SME – Small and Medium Enterprises

10 Source: https://www.buildinggreen.com/blog/we-spend-90-our-time-indoors-says-who
11 McKinsey – Resource Revolution 2011
12 Source: https://www.euenergycentre.org/images/unep%20info%20sheet%20-%20ee%20buildings.pdf