





Convegno Sezione Automazione ANIMP

SISTEMI DI AUTOMAZIONE: NUOVE SFIDE E OPPORTUNITA'

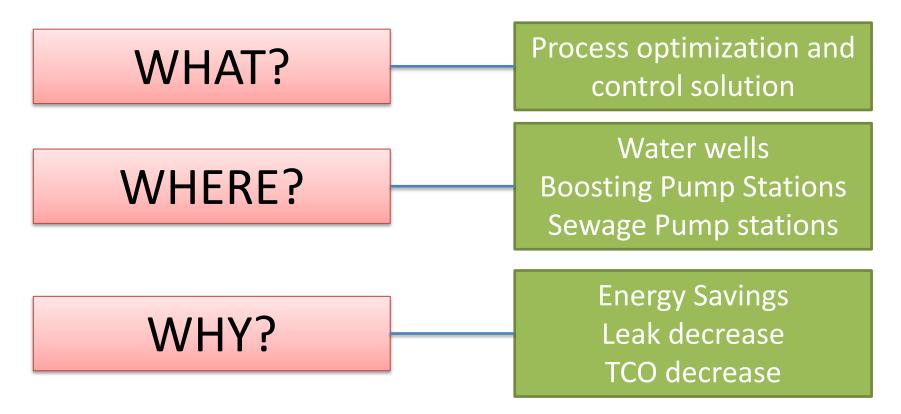
6 ottobre 2016 c/o Auditorium Maire Tecnimont (Milano)

Control and optimisation of water distribution systems in big cities By Marco Clerici

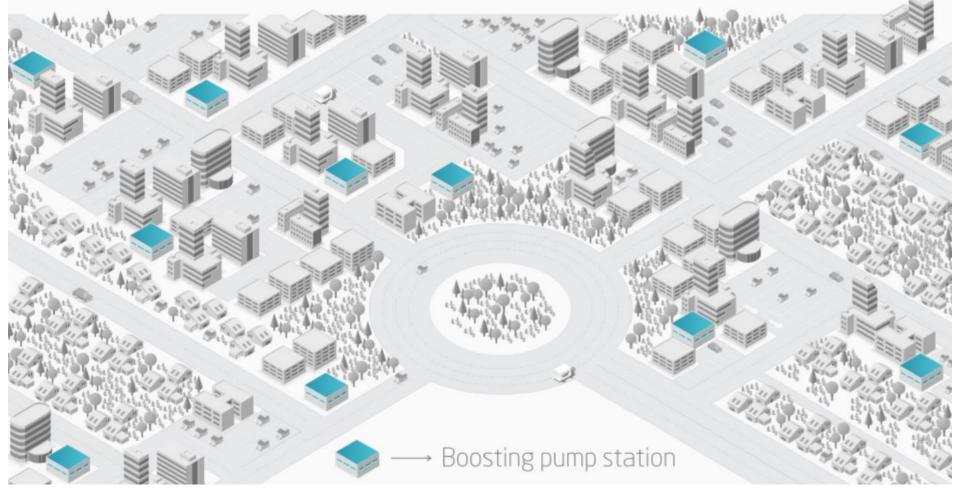
- What is Aquatoria
- Operational aspects
- Optimisation aspects
- Aquatoria structure
- Telemetry solution
- Optimisation principles
- The cases of Minsk and Cairo







BOOSTING PUMP STATIONS ARE LOCATED ALL OVER A CITY



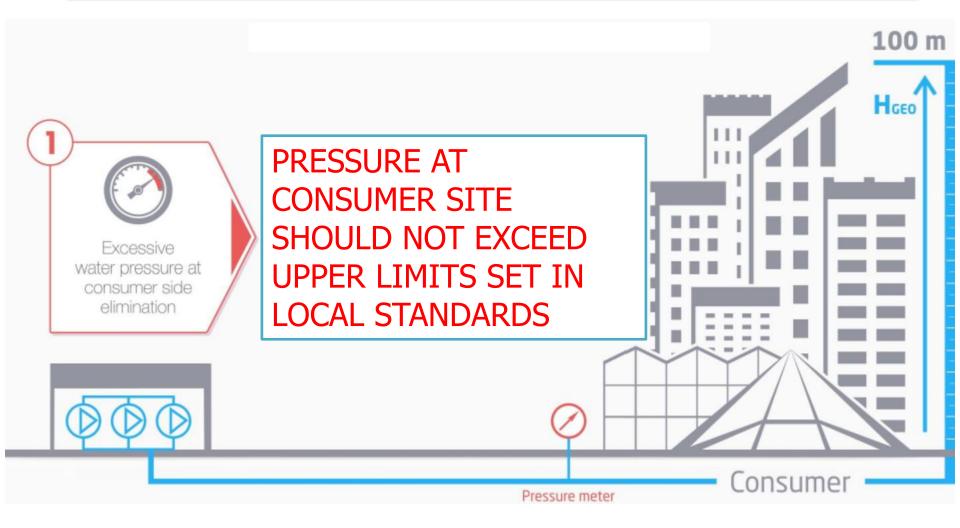
EFFICIENT BOOSTER PUMP STATIONS OPERATION ASPECTS

EXCESSIVE WATER PRESSURE AT CONSUMER SITE ELIMINATION

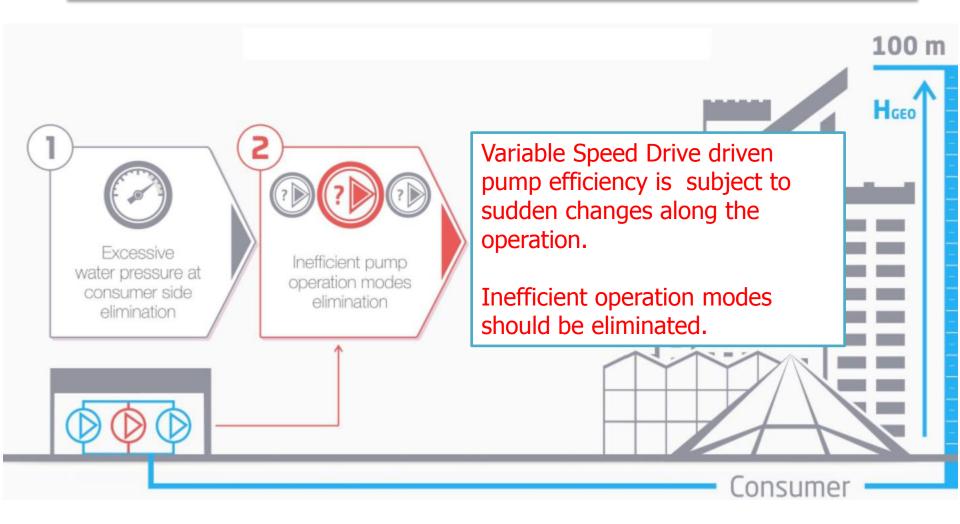
INEFFICIENT PUMP OPERATION MODE ELIMINATION

OPTIMAL PUMP SELECTION

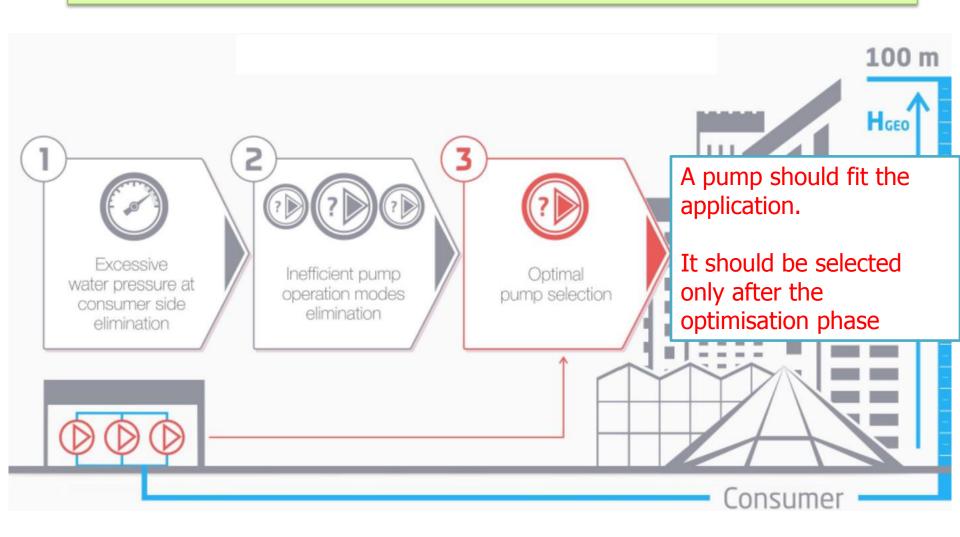
EFFICIENT BOOSTER PUMP STATIONS OPERATION ASPECTS



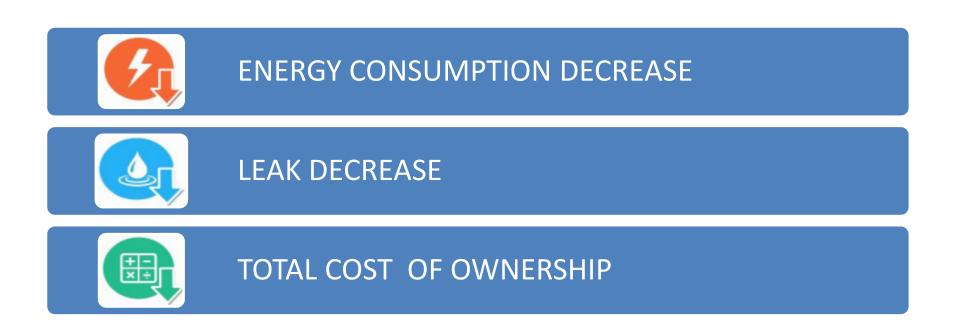
EFFICIENT BOOSTER PUMP STATIONS OPERATION ASPECTS

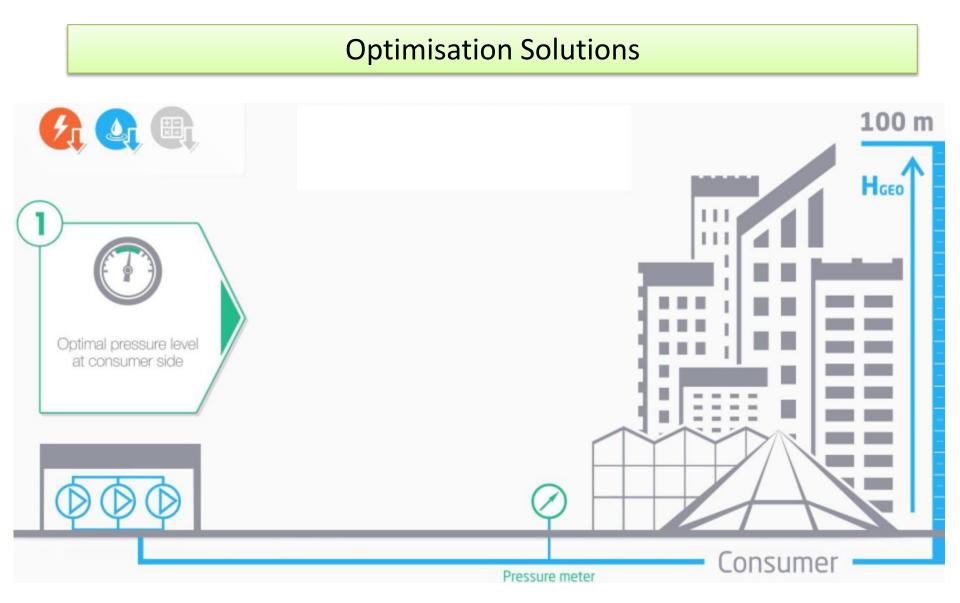


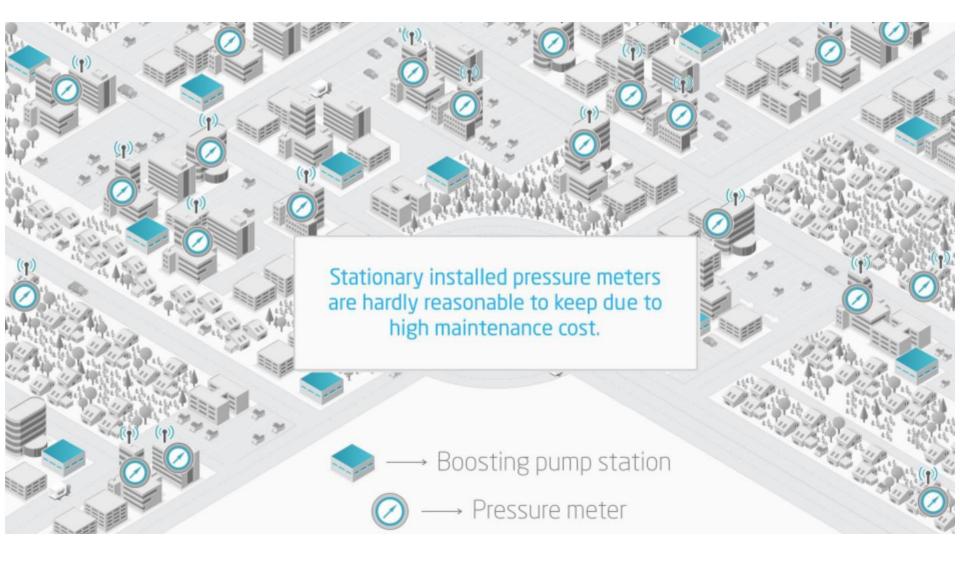
EFFICIENT BOOSTER PUMP STATIONS OPERATION ASPECTS

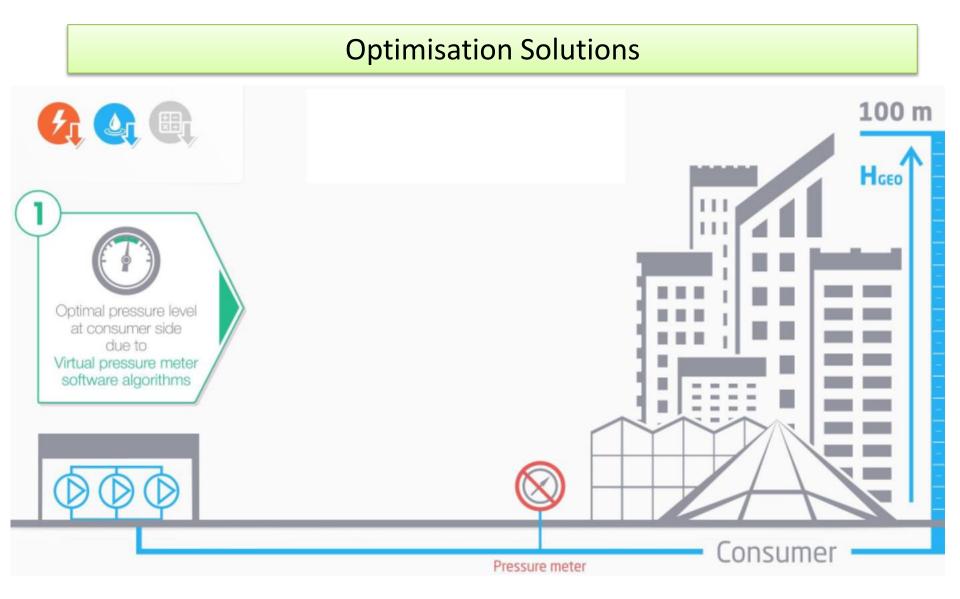


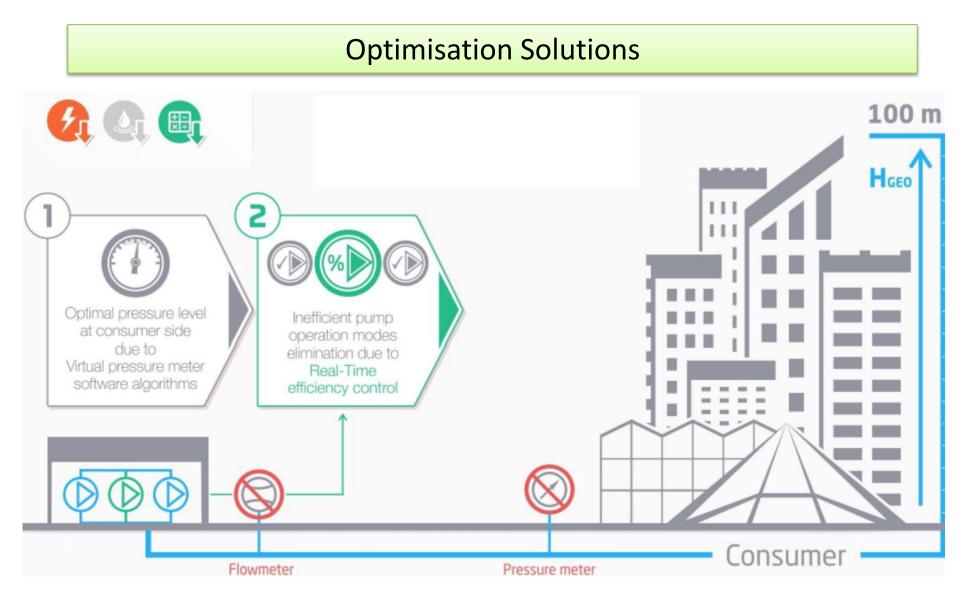
OPTIMISATION SOLUTIONS

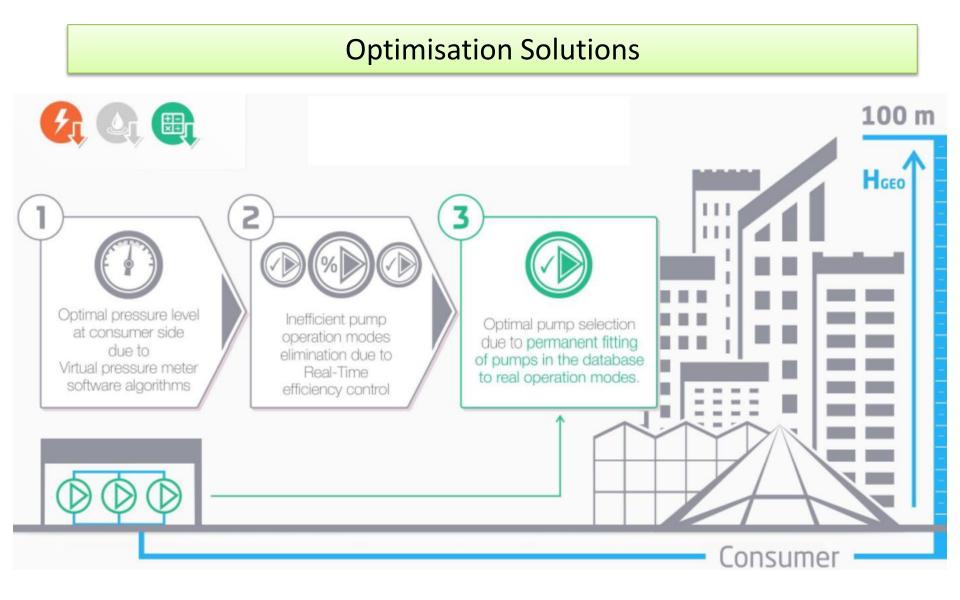












Aquatoria solution structure

Aquatoria workstation control software

Telemetry equipment

Control cabinets

Aquatoria solution structure

Aquatoria control software is based on control algorithms, parametrization and monitoring pages inside a SCADA system

| SCADA SYSTEM | | | | | | | |
|-------------------|---------------------------|--|--|--|--|--|--|
| | Application Configuration | System TCO decrease (staff costs reduction) | | | | | |
| VISUALIZATION | Adaptive Control | Energy saving alghoritms for pump station control | | | | | |
| ALARM HANDLING | Analitycal reports | Leak decrease due to comprehensive process analisys | | | | | |
| | Pump Selection Tool | Energy saving due to proper pump selection. | | | | | |
| TRENDS | Geo Module | Localization for maintenance intervention, easy parametrization. | | | | | |
| | Process Analisys Tool | Energy savings (due to precise monitoring) Leaks decrease (due to precise monitoring) | | | | | |
| ARCHIVING | | | | | | | |



Geo module Aquatoria

New Pump addition

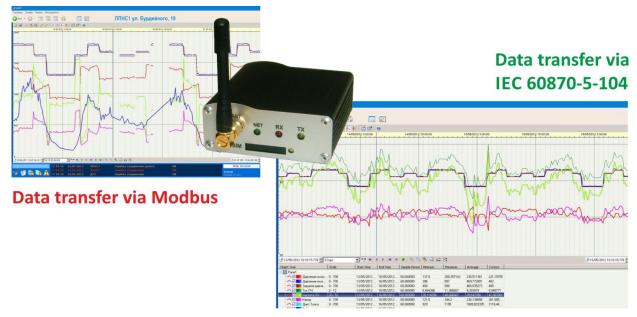
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Process analisys tool TD 2293.P3C-6 + 29 whenter

Telemetry solution

The telemetry structure of Aquatoria is based on following principles:

- \checkmark Standard PLC on the market, to comply with existing installations
- ✓ Complete data transfer, no loss of data in case of missing communication
- $\checkmark\,$ OPC technology for interface of field equipment to the SCADA
- \checkmark Single database of the process data for adaptive control implementation



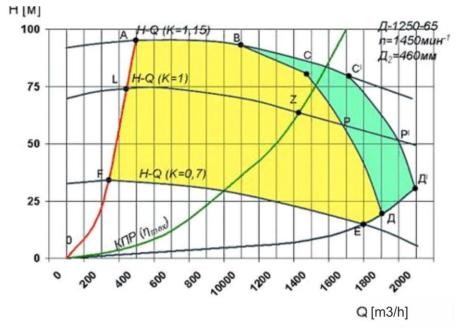
Principles of the optimization

The PLC in control cabinet collects information from pressure sensor, power consumption and pump rotation speed. These data are used in the math model in the PLC program and SCADA to calculate:

- Current pump efficiency running from an inverter
- Water pressure in remote control point

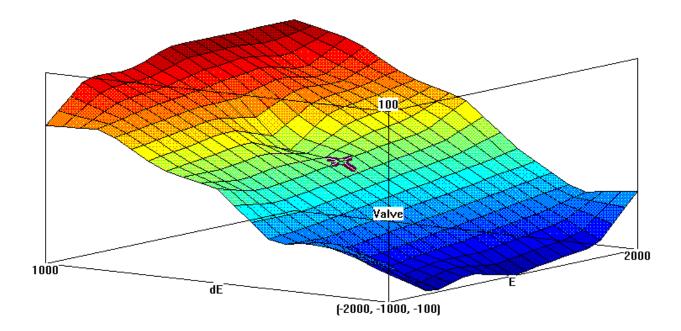
Thus, making the following possible:

- Low efficiency pump switch off
- Selection of optimal pump model based on real running modes



Principles of the optimization

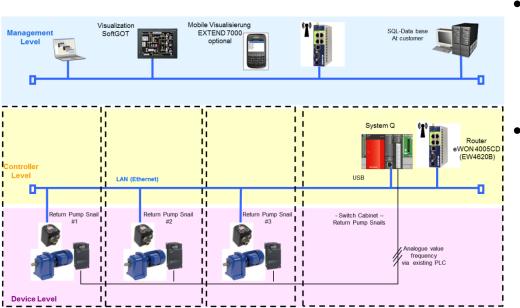
The model is actually used in a Fuzzy Control Algorithm that looks to minimize the energy consumption of groups of pumping stations linked on a common hydraulic network.



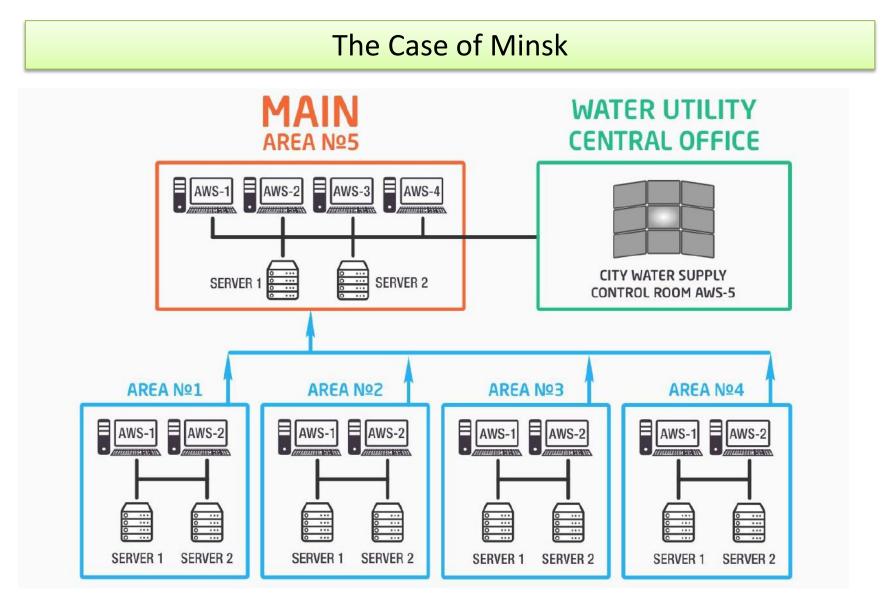
Principles of the optimization



Addition of Condition Monitoring solutions for predictive maintenance on pumps

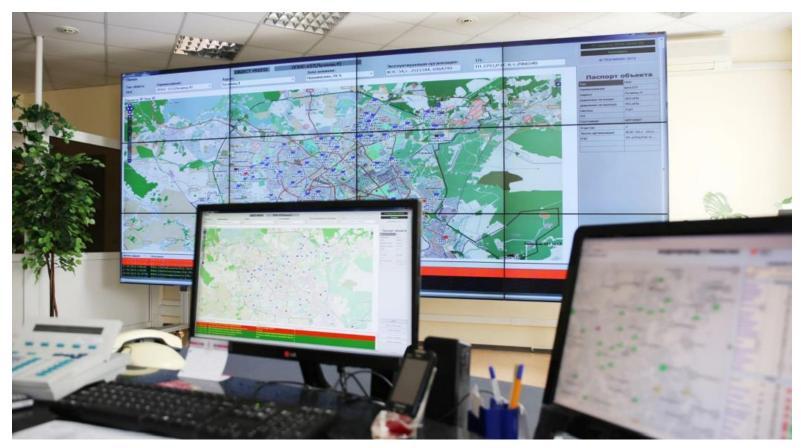


- Based on vibration and temperature sensing
 - Early detection of possible failure and indication of precise cause
- Data collection directly over telemetry to SCADA system
 - Reduction of personnel costs
 - Reduction of spare parts inventory



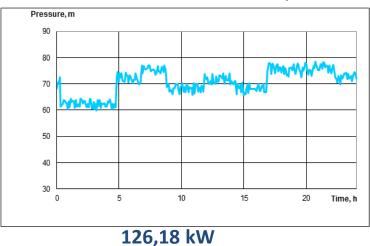
The Case of Minsk

The complete city of Minsk (around 2 Million people) is covered by Aquatoria solution



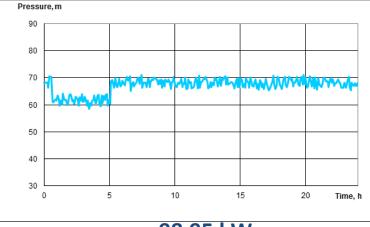
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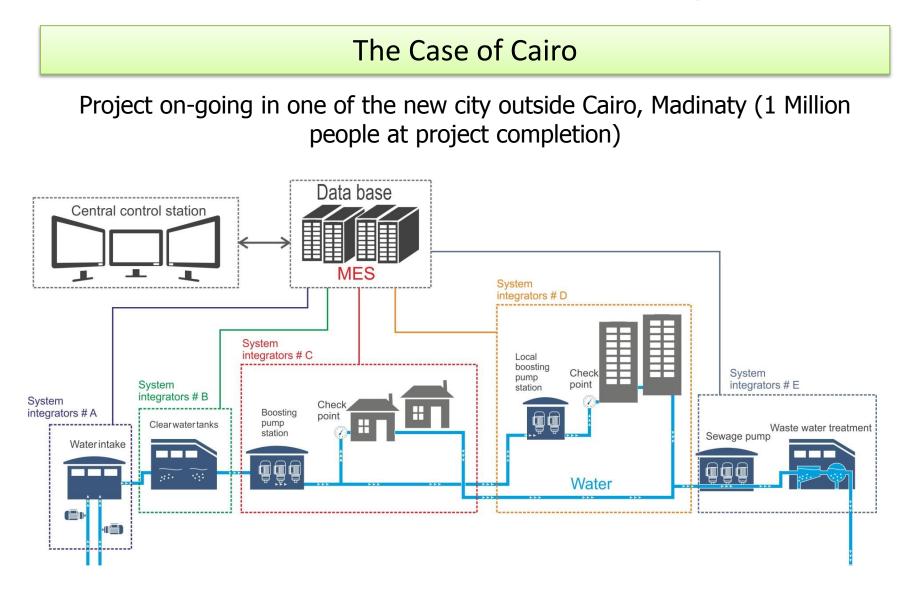
Pressure at the consumer side before optimization

Pressure at the consumer side after optimization

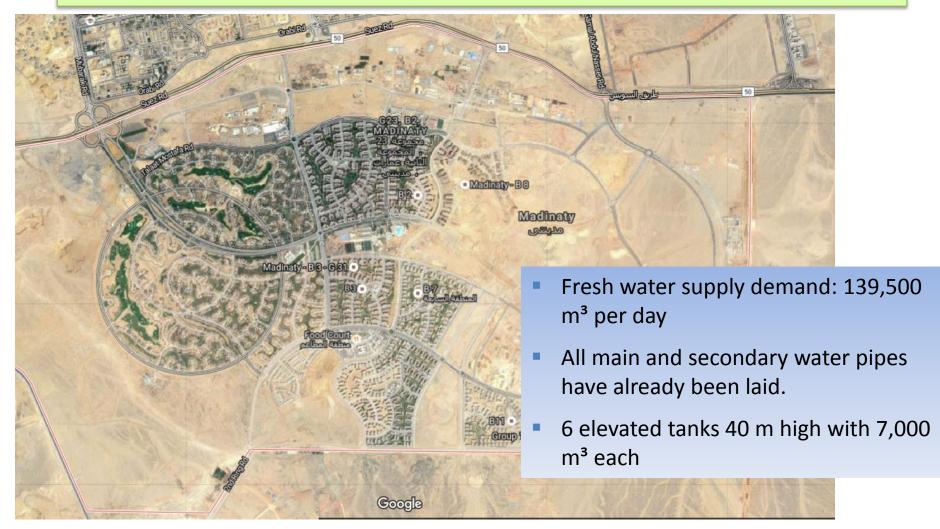


98,95 kW

| N⁰ | Characteristic | Rate |
|----|--|------------|
| 1. | Boosting pump station monthly energy consumption | 786,56 kWh |
| 2. | The average relative reduction in energy consumption by one local pump station | 17,5 % |
| 3. | Overall relative reduction in energy consumption within 11 local pump stations | 16,8 % |







The Case of Cairo

- ✓ Installation of electronically adjustable Pressure Reducing Valves (PRVs) in the city with remote control functionality: pressure fluctuations significantly decrease after PRV implementation on the tanks outlet.
- ✓ Leakages also decrease due to general water pressure decrease. Valves and PVC pipelines breakdown decrease.
- ✓ Implementation of a central SCADA system enabling the monitoring and control of the system and thus the water pressure
- ✓ Excessive water pressure reduction after implementation of adjustable PRVs with 3 pressure presets is saving approx. 5,177.5 m³ of water per day and 705.4 kWh of energy per day (annual savings: 1.9 million m³ and 257.5 MWh per year).

Grazie per la cortese attenzione