Smart City Monitor: Enabling digital transformation by Intelligent Sustainable Systems

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INTERNATIONAL WORKSHOP “SMART CITIES IN PRACTICE”, VIENNA, AUSTRIA 31 OCTOBER 2017
What is Smart City Monitor or SCM?

- Advanced web software system
- Running large model of a city or its utility services in cloud or at premises
- Linked to multiple diverse data sources via various networks (Internet, Wi-Fi, cellular, etc)
- Cost effective and easy to implement novel solution for mid & small size communities
- Developed by GOLEM IMS GmbH, Austria using Open Source Software components only
Main SCM functions

- Automatic collection of data from many sources –> Big Data
- Processing and analysing ongoing performance and sustainability status of each object and their combinations in a Big System of Systems in real time
- Transforming data streams into custom information services and controls for all community stakeholders
- Supporting effective sustainable holistic management and operations answering the question “*How are you now, My City?*”

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SCM support options for city stakeholders

• Administration and local governance in municipalities, city councils, communities
• Management of utilities and providing urban services (nexus of energy, waste, transportation, economy, social, etc)
• Public information about city processes and results
• Benchmarks comparing results for current and past periods and with other communities
• Personal digital information services for citizens
Automatic collection of data

- MS Excel and Calc files
- Databases: Postgresql, MS SQL, MySQL, Oracle, etc
- Sensors
- Smart meters, IoT
- Video cameras
- SCADA, ERP, automation and management information systems, data servers
- Mobile phone apps
MS Excel examples of source data

- Finance data by ISO 37120 model data in MS Excel files
MS Excel examples of source data

• Waste water data by ISO 37120 model data in MS Excel files

MS Excel & Calc files are imported automatically from Linux /Windows servers, Google docs, Dropbox, etc

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MS Excel examples of source data

- Solid waste monthly collection data for 23 waste collection trucks in MS Excel files saved in Google docs

Smart Urbana Use Case 3 Volvi
SCM automatically

1. Imports the data from all spreadsheet files
2. Saves local copy of data in the database
3. Calculates weight indicator for each truck
4. Analyses each collected value against planned targets for the truck operations
5. Calculates total collected weight per day (Solid Waste theme-object by ISO 37120)
6. Analyses all solid waste collected against planned targets
7. Presents results at Volvi SCM reports for Solid Waste for all stakeholders required
SCM water metering example

1. Reading water consumption data from 23,000 water meters LoRaWan linked
2. Saving local copy of data in the database
3. Calculating water consumption indicators for each consumer including costs
4. Analysing resulting values against planned targets or consumption norms per consumer
5. Calculates totals per urban area per day (Water theme-object by ISO 37120)
6. Analysing totals against planned targets
7. Presenting results at SCM reports for Water for all stakeholders required
IoT DATA SOURCES LINKING to SCM

- Databases
- Sensors
- Internet of Things
- Automated control systems
- SCADAs, ERP, MES, etc
- Web sites
- Social networks
- Anything generating data streams
- Smart Connected Assets

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Each IoT data stream can be logically linked to SCM by local connectivity solution using common IoT protocols (HTTPS, RESTful, CoAP, MQTT, etc).
Connectivity, integration and data transfer

• Data stream: Sequence of \{\textit{timestamp, value, geolocation, tags}\}
• Data transfer: any combination of networks - cable LAN, Wi-Fi, LoRaWan, Cellular, Satellite, etc
• Interface and protocols: \texttt{https, mqtt, coap, opc, etc}
• Application programming interface (API): \textbf{375 functions} supported for data exchange with third party systems enabling SCM data presentation in third party apps (e.g. Microsoft Analytics&Graph, SAS, SAP, IBM Cognos Analytics, QlikTech, Pentaho, Birst, Oracle, etc)
What are results of Digital Transformation in cities?


Yes, all together!
integrated by SCM into holistic picture of a city as a Big System of Systems with rich set of custom information, analytics, predictive and prescriptive services for different stakeholder groups.
Digital transformation of big data streams into smart information and apps using custom Open Metropolitan Assets Model (OMAM) of SC&C as complex cyber physical system linked with Smart Everything
Digital transformation everywhere
The generic SCM architecture linking the Worlds

Virtual world
Cyber

Database

Data Transformation

OMAM

Connecting the Worlds

Physical world

Smart Connected Assets

Business Layer
Open Metropolitan Assets Model (OMAM) structure by ISO 37120

City

Energy

Production

Power Stations

Renewable

Industrial

Residents

Transportation

Customers

Underground

Busses

Default OMAM template structure for development of city specific applications in SCM
Open Metropolitan Assets Model (OMAM) structure in SCM navigator
OMAM LINKS TO COMMON ADMINISTRATION STRUCTURE

Public view into OMAM as complex cyber-physical system corresponds to common municipality organisation
Theme-objects in OMAM by ISO 37120:2014

Economy
Education
Energy
Environment
Finance
Fire and Emergency Response
Governance
Health
Recreation

Safety
Shelter
Solid Waste
Telecommunications and Innovation
Urban Planning
Transportation
Wastewater
Water and Sanitation

The model structure is open to local definitions of urban infrastructure, urban processes, topology, technologies, natural resources, data sources, controls, etc.
Common Open Model structure for utility provider enterprises

Common view into an enterprise as a cyber-physical system
STANDARD PROPERTIES of SMART OBJECTS as MODEL NODES

Names, Descriptors as text
Pictures, Videos, Icons, Virtual reality, Augmented Reality
Standards summary
Tags - keywords, attributes, applications
Text descriptors, URL, etc
International Classification
Optional states (e.g. Good, Normal, Bad, Deficient)
Smart sub-objects, inheritance

Indicators
Data elements
Constants: geo-coordinates, tax …
Sensors
Cameras
Energy sources
Reports providing views to processes
Rules of state calculation depending on states of its Indicators and sub-objects
Implementing OMAM in Smart City Monitor

- Starting the City Model by ISO 37120 Themes of City Services and Indicators of Quality of Life

- Its further enhancement accordingly to local requirements, development plans and new standards e.g. 37122, 37123, 37150, 37151, etc
OMAM can have any number of objects, indicators, other elements representing infrastructure and processes of each city.
THE SYSTEM MODEL RUNS IN REAL TIME CALCULATING ONGOING STATUSES and PROPERTIES OF EACH NODE

The NODES are defined and act as SMART OBJECTS
Real time streams of big data from a huge number of diverse ongoing processes in a Smart City are transformed into

A simple, easy to understand holistic vision of the whole city as big system of systems:

How are you, my City?
WHAT IS THE CURRENT STATUS OF OUR CITY?

or its subsystems SAFETY, ENERGY, WATER, WASTE, TRANSPORT, HEALTH, Environment, etc ...

EXCELLENT!
OPTIMAL.
DEFICIENT?
Smart City Monitor demo enabling vision of city sustainability in real time: http://pharosnavigator.com
Looking into the near future: New SCM functions under development

System knows all major metropolitan processes and analyses them in real time using methods of Artificial Intelligence

Holistic integrated view into the city life is customized depending on specific user role (manager, operator, technician, citizen, tourist)

Detailed analytics on demand enabling transparency and prediction

Best User Experience and Interface design, augmented and virtual reality, personalisation of interests and life patterns

Focused advisory for stakeholders regarding effective operations ensuring sustainability, green regenerative circular economy and energy

Systematic pursuing goals of increasing SCC quality of life, resilience and quality of local governance based on AI advisory and evidence
SCM is a service provided to city administrations, utility providers and local businesses under licensing agreement.

SCM Customer obtains own copyrights for its local application model.

Customer runs and administers its SCM engine and model independently.

Data access rights in reports, dashboards, mobile apps, linkages to local data sources and user groups are administered by customer.

Consulting, training and support services for project preparation and implementation are provided under additional agreements.

PharosN platform running SCM applications continuously upgraded by GOLEM IMS GMBH for all customers as service subscribers.
Technical details of PharosN platform

- Build on Open Source software components only (Linux, docker, Apache, node.js, Postgresql, poco, qt5, C++, javascript, jquery, d3.js, etc)
- Web clients run in all major web browsers in Windows, Android, IOS
- Open agile, scalable client-server architecture, docker enabled
- Run time computing environment: in cloud or at-premises servers
- Interactive reports, dashboards: js/html/css web pages real time
- Central portal: Self management of own virtual organisations and engines by subscribers, automatic version updates, e-learning
- Connectivity: Internet, local cable and Wi-Fi networks, cellular
- Security: https, websockets, SSL keys 2048, AES 256 encryption
- Scalability vertical (performing) and horizontal (adding hardware)
- Powerful yet simple in use instruments for custom model building
Availability of SCM for small and medium communities and asset managers

• Annual license subscription
• Fees are negotiable for a community budget
• Implementation and project planning support

*The unique advanced digital transformation system for smart sustainable communities is available now!*
Service portal and online demos:  
http://pharosnavigator.com

Twitter:    @MonitorSmart

Contact:   info@golem.at