

# **THE SCATOL8<sup>®</sup> FOR SUSTAINABILITY: AN UPDATE ON THE REMOTE SENSING SYSTEM OF ENVIRONMENTAL, LANDSCAPE AND MANAGEMENT VARIABLES**

**Professor Riccardo BELTRAMO, Ph.D.**

University of Torino, Department of Commodity Science

**Professor Sergio MARGARITA, Ph.D.**

University of Torino, Department of Management

## **Abstract:**

This paper describes the evolution of Scatol8<sup>®</sup>, a remote sensing system conceived and developed within the Department of Commodity Science (DCS) of the University of Torino.

The DCS developed, along the years, several projects related to Sustainable Management of economic organizations; the first part of the paper summarizes the key-elements of projects that enriched the knowledge base, providing hints that took to Scatol8<sup>®</sup>.

Scatol8<sup>®</sup>'s vision has been described in a previous paper. Its basic elements form the second part of the paper. The third part is devoted to describe several activities that have been undertaken, which display the potential of the Scatol8<sup>®</sup>'s system along directions not foreseen at the beginning; the description is splitted into Research projects and Education initiatives.

**Key words:** Sustainable Management, Remote sensing, Environmental and Landscape, Management System, Innovation, Simulation models, School Network

**JEL Classification:** I25, L66, M11, M31, O13, O31, Q56

## **1. DOCS and sustainability**

The core activities of the DCS of the University of Torino are research and teaching in sustainable development. Around fifty projects, at national and international level have been designed, launched and produced, the period..... , by finding, from time to time, adequate funding.

Since the '90s, the DCS is very active in applied research, to develop methodologies and tools for environment qualification of organizations and territories. Topics covered by multidisciplinary research groups range from

enhancement of typical and traditional agricultural food production, environmental management of manufacturing and services - with an emphasis on tourist facilities -, environmental sciences and technologies, conservation and recycling of natural resources, environmental management and control as well as on the study and application of environmental management systems.

Within these issues, the following researches are worthy to be considered:

- Project CRESTA - Environmental Management System for the Rifugio Regina Margherita. Launched on 1997, it ended on 2002 with ISO 14001 certification of the highest mountain hut in Europe. It was the first research with a systemic view conducted in mountain huts, to verify the applicability of environmental management system to small tourist accommodation. After the identification of environmental significant aspects, to reach an environmental and economic optimum, a multidisciplinary team worked to adapt the European standard to the peculiar context and to draw proper operative instructions.

- Strategies of sustainable tourism developed in Aosta Valley, Piedmont and Liguria. The experimental work in mountain huts took us to involve more than 30 huts' managers whose role was helpful to write guidelines, available in four languages, to lead courses and other initiatives on environmental education in mountain refuges. This multiannual engagement took to the WWF award of the Golden Panda, for the continuing action on sustainable tourism in the Alps,

- Participation to K2 Italian alpine expedition (Pakistan), on 2004, to design and implement the Environmental management system of the expedition. This on field research assured the complete control on the environmental aspects, sharing the operative instructions with participants of different roles and nationalities. Result of this experience were guidelines that are being spread throughout the remote mountainous areas of the world.

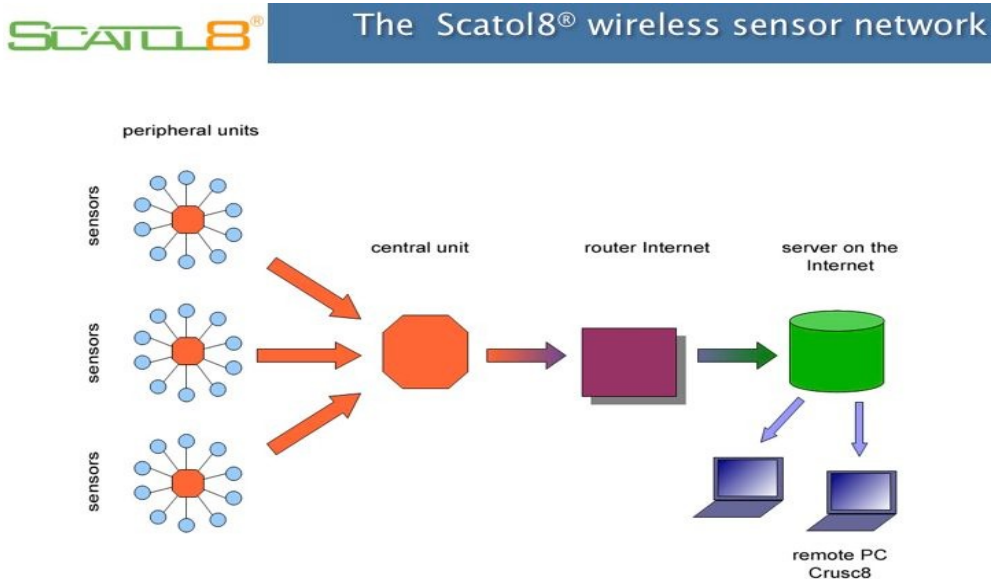
- Research on Environmental and Landscape Management System (ELMS). The four years research, which was implemented in the municipalities of Langa and the Barolo, took to a proposal for an evolution of the European Regulation EC n. 761/2001 (EMAS II), which sees its integration with the principles of the European Landscape Convention (ELC). This new method increases the benefits of EMAS and visibly the declination of the principles on a regional scale, promoting the value of the landscape, its conservation and enhancement, through the active involvement of population and economic actors.

- Interreg Project (2007-2013) "VETTA, Enhancement experiences of Transboundary Tours and products of high and medium altitude", with the involvement of 52 mountain huts. These accommodations have environmental aspects related to the most popular organizations, including domestic reality and landscape aspects of excellence, which help to make them the attractors of a growing number of tourists.

Sustainability is not just a matter of business, but it is associated with everyone's daily life, with consumers's choices and behavior. Internalize this principle and to adjust accordingly, their decision-making models is possible if

you have data that express the pressure on resources and the environment. The Scatol8<sup>®</sup> was born for this!

## 2. Scatolo 8<sup>®</sup> in short



The Scatol8<sup>®</sup> is a remote sensing network of environmental, landscape and management variables, created at the DCS, entirely based on free and open technology (hardware and software) (Open Source), with a view of controlling costs, of openness and ease of access. The choice of the name Scatol8<sup>®</sup> conveys the idea of a friendly device, handmade, easy to understand and easy to use, so affordable.

As described in Fig. 1, Scatol8<sup>®</sup> consists of a central unit and of peripheral (end) units, connected in a network. Numerous sensors, able to detect the monitored variables, are connected to peripheral units which transmit the data to a central unit, connected with a server. Sensors and peripheral units change in type and numbers depending on customers' requirements.

Collected data are transmitted to a personal computer, where they are stored, processed and displayed by an instrument digital panel, called the Crusc8. Thus, you can create a real-time monitoring of each measured variable, as well as evaluate their performance over time, thanks to the display of time series.

In turn, the personal computer is able to upload data on a server on the Internet; the server collects and organizes them in a collective database. Data can be input for environmental management systems and/or for actuators (i.e. a wide range of devices, from leds to motors).

The part list is the following:

END NODE	
Main parts	Brief
Arduino uno	The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins and 6 analog inputs.
Wireless sd shield	Shield that acts like a socket for the bees modules and that contains an SD to store data in if the coordinator node is temporarily unavailable
xBee	XBee and XBee-PRO ZB ZigBee modules from digi provide cost-effective wireless connectivity to devices in ZigBee mesh networks
Rtc	The real time clock DS1307 is used to add a timestamp to every sample
Brick shield	This shield replies the power supply, the ground and other signals from the ATmega many times. It is used to easily connect all the sensors and the RTC to the microcontroller

COORDINATOR NODE	
Main parts	Brief
Arduino MEGA	The Arduino Mega is a microcontroller board based on the ATmega2560. It differs for the one used in the end node basically because it offers more memory to run programs
Ethernet shield	It connect the microcontroller to the internet using the TCP protocol to send data to the server
xBee	XBee and XBee-PRO ZB ZigBee modules from digi provide cost-effective wireless connectivity to devices in ZigBee mesh networks
Wireless shield	It interfaces the Xbee radio to the microcontroller

Until now, the set of variables the system is capable of monitoring is illustrated in the following table:

variable	unit of measurement
Outdoor temperature	°C
Relative humidity	%
Snowfall level	m
Precipitation level	m
Wind speed	m/s
Wind direction	degree
Illumination level	Lux
Air emission quality	Presence of LPG, butane, smoke, propane, methane, alcohol, hydrogen
Water consumption	l/s
Electric energy	W/h
Solid waste quantity	Kg
Waste water quality	pH, ORP
Presence	number
Landscape view	

## **Guidelines of Scatol8®**

Designed in the perspective of sustainability, Scatol8® is inspired in its creation and implementation to various criteria, such as:

- **Open Source.** Hardware and software are fully based on open technologies and software (Open Source) in view of cost containment, openness and ease of access, even for training purposes;

- **Modularity.** The system is constituted from time to time, according to the requirements and specifications of each application;

- **Environmental compatibility.** All collection and processing devices are placed in recycled containers, coming mainly from food and electronics industry, transformed and adapted to their new function, or in containers made of wood (a renewable resource), or even cardboard.

- **Knowledge dissemination.** The Scatol8® is not only a product, but also an initiative to spread knowledge, which aims to involve young people in the creation of technology (and not only in its use), which is accompanied by information tools on the relationship between observed variables and sustainability and proposes the reuse of components through the concrete realization of the active systems.

The **implementation of hardware and software** is entrusted to Ing. Paolo Cantore who takes part in the definition of the technical specifications of the circuits, designed them and takes care of selecting sensors and microprocessors, conducting tests in DCS Lab to verify accuracy and reliability, within the economic constraints. When the testing phase reaches satisfactory results, Scatol8® is packed in customized packaging. Finally, systems are installed and tested by Scatol8® 's Team in real conditions. Afterwards, the phase of writing technical documentation and reports begins.

**Communication** plays a key role in the Scatol8®. it presents a number of problems because there are different subjects to which it is addressed (teachers, students, entrepreneurs of various productive sectors) and the means (website, social networks, brochures, research reports). A multilayer communication is carried out continuously, providing news updates to stimulate reflections and to keep the attention, to arouse curiosity in the potential of the system and to encourage involvement in the project proposals. Given the importance of these instances, in the organizational structure of the team Scatol8® has been inserted the "Communication" function, assigned to the Architect Camilla Botto Poala. As noted above, a great importance is given to the packaging that plays a role in communicating the values associated to Scatol8®. For this reason, she is also entrusted with the responsibility of the trials conducted on packaging recovery that must meet functional and communicational requirements that change depending on to the context.

### **3. Scatol8®'s in Research projects**

**Scatol8®** makes it possible to simultaneously monitor different variables and multiply the number of these variables as necessary: the configuration of a network in a domestic unit is similar to the needs satisfied in mountain huts, that despite their structural peculiarities, exemplify application Scatol8® inside a building.

Being able to store and view the captured data in real time and compare, thanks to the series, the environmental performance of a building (including not only the technological characteristics of the building and the materials used, but also plant components) together with the temperature and humidity characteristics of the interior, put the remote sensing system as a useful tool for understanding and monitoring of building in question.

In addition to displaying the data collected continuously, also be carried out remotely, the system can convey a subsequent processing and analysis of the historical data collected in order to build maintenance actions or, where necessary, to improve the management of activities carried out in the domestic unit.

#### **3.1. Scatol8®'s indoor applications**

##### **Scatol8®'s in accomodations**

The sparks that took to Scatol8® has been the EU funded Interreg Project (2007-2013) "VETTA, Exploitation of Transboundary Tourist Experiences and products of medium and High altitude". Within the actions assigned to the DCS, there is a pilot project aimed to design and carry out three Wireless Sensor Networks (WSN) in as many mountain huts of Verbania province. In the summer of 2011 and 2012 Scatol8® systems were first tested and then installed permanently.

##### **Scatol8®'s in manufacturing companies**

The DCS is engaged, with the University of Gastronomic Sciences and the Polytechnic of Torino in the project POLIEDRO - Pollenzo Index Environmental and Economics Design whose aim is the developing of a sustainability index for agro-industrial production in Piedmont.

In particular, the DCS is committed to design the index, through the application and execution of Life Cycle Analysis on food products typical of our region. The need to overcome the reference data, often lacking or so generic to be