NEW PERSPECTIVES IN DEFINITION, CLASSIFICATION AND DESCRIPTION OF MOBILE SOIL PROTECTION APPLICATIONS

Bogdan-Vasile CIORUȚA[1-3#], Kateryna RADLOVSKA[4], Mirela COMAN[1,5], Monica LAURAN[3,6], Ioana-Elisabeta SABOU[3]

[1] University of Agricultural Sciences and Veterinary Medicine in Cluj-Napoca, Doctoral School, Calea Mănăştur 3-5, 400372, Cluj-Napoca, Romania; mail: bogdan-vasile.cioruta@usamvcluj.ro
[2] Technical University of Cluj-Napoca - North University Center of Baia Mare, Office of Informatics, 62A Victor Babeş Str., 430083, Baia Mare, Romania; mail: bogdan.cioruta@staff.utcluj.ro
[3] Technical University of Cluj-Napoca - North University Center of Baia Mare, Department of Specialty with Psychopedagogical Profile, 76 Victoriei Str., 430072, Baia Mare, Romania; mail: sabou.va.ioana@student.utcluj.ro
[4] Ivano-Frankivsk National Technical University of Oil and Gas, Department of Ecology, 15 Karpatska Street, Kolomyia, Ivano-Frankivs'ka oblast 76008, Ukraine; mail: kateryna.radlovska@nung.edu.ua
[5] Technical University of Cluj-Napoca - North University Center of Baia Mare, Faculty of Engineering, 62A Victor Babeş Str., 430083, Baia Mare, Romania; mail: mirela.coman@irmmm.utcluj.ro
[6] Technical University of Cluj-Napoca - North University Center of Baia Mare, Faculty of Science, 76 Victoriei Str., 430072, Baia Mare, Romania; mail: monica.lauran@mi.utcluj.ro

RESEARCH ARTICLE

Abstract

Nowadays, almost all fields of activity are based on the use of information technologies and various devices (more or less mobile) with related applications. Soil monitoring and protection activities are no exception. Thus, both IT devices and systems and related mobile applications are of real interest in the development of sustainable and precision agriculture, as well as the development of the community as a whole. As such, through this paper, starting from classical computer systems, we aimed to define and classify, in association with them, both systems and mobile applications for monitoring and protection of soils. A new typology of mobile systems and applications with implications for soil monitoring and protection has resulted in these conditions, which can be agreed upon by the academic community and those with concerns in the field. Consequently, we should also adjust the community's perception of the implications of information systems, e-learning, and m-learning in Community agricultural practice and policies.

Keywords: soil protection, computer systems, mobile learning, dedicated mobile applications.
#Corresponding author: Bogdan-Vasile CIORUȚA bogdan-vasile.cioruta@usamvcluj.ro

INTRODUCTION

Nowadays, almost all fields of activity are based on the use, to a greater or lesser extent, of information technology and various computing devices with related applications. Thus, the use of means and tools specific to Information and Communication Technology (ICT) in carrying out various activities and making decisions has become ubiquitous (Cioruța et. al, 2018; Mesaroș et. al, 2018).

The availability of computers, in terms of cost and use, has allowed a steady evolution of Environmental Information Systems (EISs) and Environmental Informatics (EI), with the constant need to develop increasingly complex working tools compatible with the requirements of various environmental phenomena (Cioruța and Coman, 2011a).

Areas of activity related to soil protection are no exception. Thus, of real interest both for the general public and for the entities with concerns in the field, the classic computer systems have been replaced by EISs, the latter becoming more and more sought after and handy to use (Cioruța and Coman, 2011b; Cioruța et. al, 2013), as they provided an answer to the environmental problems as they need solutions appropriate to our days.

From applications and platforms that indicate in real-time the weather in a certain area to dedicated software that establishes various alternatives to work scenarios in terms of community-environment relationship, we are talking about a diversified range of EISs (Cioruța and Coman, 2019-2021). All are based on the configuration, structure, and properties of classical computer systems, facilitating through the use of new technologies the intimate, direct, and immediate approach to user information (Cioruța et. al, 2012-2014).

Starting from the field situation, EISs end up acquiring, processing, storing, and disseminating data to serve the interests of users (more or less specialized) and the community. Thus, in this paper, we set out to discuss EISs (which include mobile applications dedicated to soil protection), thus trying, in relation to classical computer systems to define and classify them.

MATERIAL AND METHOD

The first step in structuring our research was to consult the literature, where we identified numerous references to the definition and characterization of SIM (Avouris and Page, 1995; Hilty et al., 1995; Gunter, 1998; Cioruța and Coman, 2011a; Cioruța and Coman, 2012). In parallel with the information obtained, and by reference to classical computer systems, we defined and classified mobile applications for soil protection. Both the definition, especially the classification of mobile applications dedicated to soil protection, were milestones for us, given that in the literature we failed to identify such an approach.

In response, we analyzed and synthesized a series of subjective aspects, which naturally also found adequate graphic landmarks as we claim (Cioruța and Coman, 2021); in the first instance it includes the typology of the classification of mobile applications (see Fig. 1), to later emphasize the scope and reporting of information obtained from the field (see Fig. 2), and the role of applications in relation to the status and responsibilities of users (see Fig. 3).

For all three graphics, we referred to SmartArt graphics, trying to keep the explanations and details to a minimum. In fact, in order to remain consistent in reporting to computer systems, we also resorted to shortening the typology of mobile applications, thus facilitating the perception of readers and users on them.

RESULTS AND DISCUSSIONS

In general, EISs work with data that captures the attributes of the environment from which it was extracted. Data taken from the environment represent quantitative or qualitative attributes of a variable or set of variables (Cioruța and Coman, 2014; Cioruța and Coman, 2019); these are the result of measurements and can form the basis for the creation of field observation sheets, graphs, and maps, or other forms of representation on the issues under investigation.

In order to become environmental information, the data subject to research must be processed in accordance with the requirements of the user and those imposed by the research (Hreniuc et. al, 2019); this involves collecting data from various sources, namely processing and distributing the results of processing to the user. Consequently, the objective of data processing is to convert environmental data into environmental information that underpins decisions.

The main differences between data and information are that data are primary attributes collected from various places, undefined or unorganized in a form that underpins decisions, while information is messages obtained through data processing, they must be concise, current, complete, and clear, so as to meet the demands of the research.

Today, environmental data is processed automatically, using electronic automatic processing equipment, also known as Automatic Data Processing Systems (ADPS). EISs, which include to some extent the ADPSs, as well as mobile applications with implications for soil protection, under the generic term of Soil Data Processing Systems (SDPSs), are classified according to several criteria (Kamran et. Al., 2016), so:

1) Depending on the field of use, computer applications may be:
   a. for the management of economic and social activities in relation to land use and soil protection;
   b. for the management of technological processes in relation to land use and soil protection;
   c. for scientific research, technological design, and innovation in relation to soil protection.
2) Depending on the element under analysis, we are dealing with:
   a. computer systems aimed at obtaining data and generating information and knowledge;
   b. object-oriented computer systems;
   c. function-oriented computer systems;
   d. process-oriented computer systems.
3) According to the way of organizing the data with reference to the ground, we have:
   a. file-based computer systems;

b. computer systems based on hierarchical, network, relational, or object-oriented databases;
c. mixed computer systems.

4) According to the method used in the design of mobile applications dedicated to soil protection, we have:
a. applications developed according to the systems method;
b. applications developed according to the classical life cycle method;
c. applications developed according to the structured method;
d. applications developed according to the object-oriented method;
e. applications developed by the fast method (RAD);
f. applications developed according to the mixed team's method;
g. applications developed according to the prototype method.

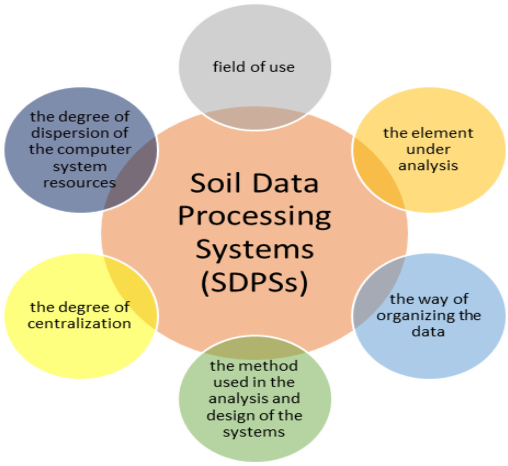

Figure 1. **The first 6 classifications criteria for Soil Data Processing Systems (SDPSs)**

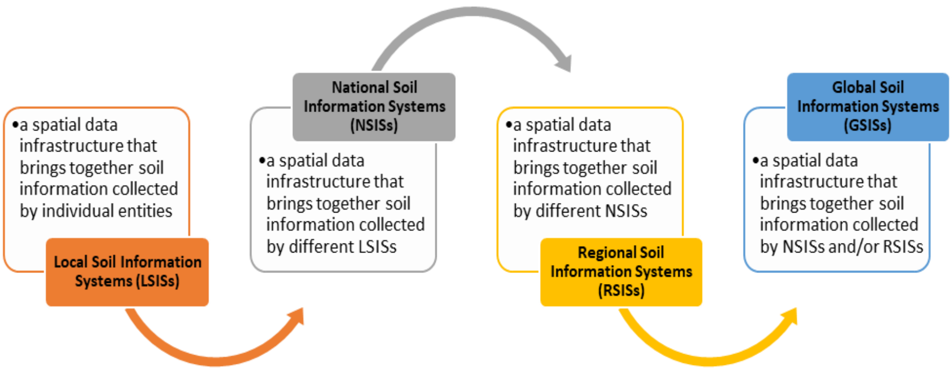

Figure 2. **The Soil Data Processing Systems (SDPSs) classification by data coverage area**

5) According to the degree of centralization of the functionalities, we have:
a. centralized applications/systems;
b. decentralized applications / systems.

6) According to the degree of dispersion of the computer system resources involved in the acquisition, processing, storage, and dissemination of data, we have:
a. Local computer applications or systems (based on local area network, workstations);
b. Distributed computer applications or systems (distributed data).

Because information on the protection of soil resources is needed both to answer critical questions on a global scale and to provide the global context for local decisions, a classification by centralized data and information is also required. Thus, in the 7th category, depending on the area of data and information that it centralizes, we have:

a. Local Soil Information Systems (LSISs) aims to develop a spatial data infrastructure that brings together soil data and information collected individually by entities;

b. National Soil Information Systems (NSISs) aims to develop a spatial data infrastructure that brings together soil data and information collected by several different LSISs;
c. Regional Soil Information Systems (RSISs) aims to develop a spatial data infrastructure that brings together soil data and information collected by several different NSISs;
d. Global Soil Information Systems (GSISs) aims to develop a spatial data infrastructure that brings together soil data and information collected by several different NSISs and/or RSISs.

The latter systems (GSISs) are designed as a federation of information systems, which share interoperable data sets about the ground via web services. This approach empowers countries to develop their SPDSs as reference centers for soil information.

In fact, most entities that process information related to soil protection use up to 5 different SPDSs, each with functionalities that help manage a particular organizational unit. This is how SPDSs helps each department manage and organize all of its data in a way that helps unit members achieve key objectives. If the data collected by an SPDSs is relevant and accurate, the organization may use it to streamline tasks, identify inefficiencies, and improve services for customers and/or users with concerns about land protection or land use. The use of all 5 SPDSs allows a company to maintain a competitive advantage, find growth opportunities and maintain an accurate audit trail of traded data and information. Below, we present an overview of the 5 SPDSs, their role, and how they work, thus delimiting the 8th category:

a. Office Automation Systems (OASs) are a network of tools, technologies, and resources needed to perform office processing tasks. maintaining a calendar of activities and generating reports.

First of all, an office automation system helps to improve communi-cation between different departments so that everyone can work together to complete a task. By using an office automation system, entities concerned with soil protection can improve communication between employees, streamline activities, and optimize the management of soil data and information.

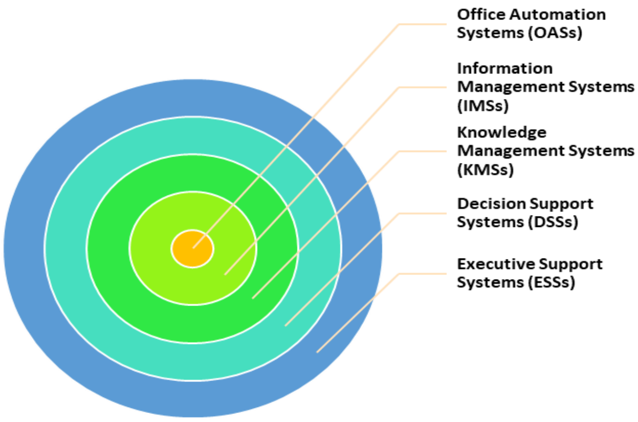

Figure 3. **The Soil Data Processing Systems (SDPSs) classification by system functionality**

b. Information Management Systems (IMS) store and retrieve information to help users improve their knowledge and optimize collaborative efforts to complete tasks.

These systems provide intuitive access to external information required by workers who need external knowledge to perform their roles.

c. Knowledge Management Systems (SMCs) use transaction information, retrieve information, aggregate it, and generate reports to help management know important situation details.

Summaries and comparisons are used to enable senior managers to optimize their decision-making process for better results.

d. Decision Support Systems (DSSs) process information to help make decisions. Decision templates are programmed to analyze and summarize large amounts of information and put them into a picture that makes them easy to understand.

This provides the evidence needed for the average management to make the right choices to ensure that the company meets its objectives for the protection of soil resources, for example.

e. Executive Support Systems (SSE) are similar to DSSs but are used by executives and owners to optimize decision-making.

Such systems help those interested to find answers to unusual questions so that they can make choices that improve the company's perspective and performance in relation to soil protection. Unlike a DSS, an executive support system offers better telecommunications functionality and greater computing functionality.

CONCLUSIONS

Environmental Information Systems, as well as mobile applications for soil protection, are tools that are gaining new value in the acquisition, processing, storage, and dissemination of information. I made a series of observations on them and made a review of a new typology.

The latter is shaped by the field of use, the element under analysis, the way data is organized, the method used in designing mobile applications, the degree of centralization of functionality, and the degree of dispersion of computer system resources. The typology is also completed with classification according to the area of coverage of the data and information they centralize, respectively according to the role and the way in which the applications themselves work.

REFERENCES

Avouris N.M., Page B., 1995, Environmental Informatics: Methodology and Applications of Environmental Information Processing, Kluwer Academic, Boston

Cioruța B., Cioruța A., Coman M., 2012, Pledoarie pentru necesitatea formării unei culturi informaționale environmentale, Journal of Environmental Research and Protection (ECOTERRA®), Universitatea Babeș-Bolyai Cluj-Napoca, nr. 30, pg. 31-39 www.ecoterra-online.ro/files/1339069625.pdf

Cioruța B., Coman M., (2021) Implications of Mobile-based Information Systems in the Contaminated Soils Characterization, Natural Resources and Sustainable Development (NRSD®), 11(2): 135-142. https://www.nrsdj.com/issues-year-2021-2/implications-of-mobile-based-information-systems-in-contaminated-soils-characterization.html#.YlPqapFBxPY

Cioruța B., Coman M., 2011, Evoluția, definirea și rolul Sistemelor Informatice de Mediu în dezvoltarea strategiilor pentru protecția mediului, Journal of Environmental Research and Protection (ECOTERRA®), Universitatea Babeș-Bolyai Cluj-Napoca, ISSN tipărit 1584-7071, ISSN electronic 2248-3128, nr. 27, pg. 11-14 www.ecoterra-online.ro/files/1321371401.pdf

Cioruța B., Coman M., 2011, Incursiune în cercetarea științifică modernă a mediului înconjurător. De la Sistemele Informatice de Mediu la Informatica Mediului, Journal of Environmental Research and Protection (ECOTERRA®), Universitatea Babeș-Bolyai Cluj-Napoca, ISSN tipărit 1584-7071, ISSN electronic 2248-3128, nr. 29, pg. 17-20 www.ecoterra-online.ro/files/1330955124.pdf

Cioruța B., Coman M., 2012, Environmental Informatics - solutions and emerging challenges in environmental protection, Studia Universitatis Babeș-Bolyai AMBIENTUM, vol. 57, no. 2, pg. 17-30, International Conference „Environmental Legislation, Safety Engineering and Disaster Management", 25-27 octombrie 2012, Cluj-Napoca http://studia.ubbcluj.ro/download/pdf/903.pdf

Cioruţa B., Coman M., 2014, SoilApp Monitor - Environmental Information System for potentially contaminated sites characterization, Scientific Bulletin of North University Center of Baia Mare, Series D, Mining, Mineral Processing, Non-ferrous Metallurgy, Geology, and Environmental Engineering, vol. 28, no. 1, pg. 43-49, Baia Mare

Cioruța B., Coman M., 2019, Considerations regarding the implications of mobile-based Environmental Information Systems in contaminated soils characterization, Journal of Documentation, Research and Professional Training (ProEnvironment®), 12(38): 127-131 http://journals.usamvcluj.ro/index.php/promediu/article/view/13638/11227

Cioruța B., Coman M., 2019, From Enviromatics to Sustainable Informatics: beyond the definition and conceptual delimitations, Ecological Safety and Balanced Use of Resources, 1(19): 7-18. https://doi.org/10.31471/2415-3184-2019-1(19)-7-18

Cioruța B., Coman M., Cioruța A.A., Lauran A., 2018, From Human-Environment Interaction to Environmental Informatics (I): Theoretical and Practical Implications of Knowledge-based Computing, Magazine of Hydraulics, Pneumatics, Tribology, Ecology, Sensorics, Mechatronics (Hidraulica®), nr. 1, pg. 71-82 https://hidraulica.fluidas.ro/2018/nr1/71-82.pdf

Cioruţa B., Coman M., Mateșan V., 2013, Environmental Information Systems: solutions and emerging challenges for the modern strategic development of Romanian local communities, International Conference "Scientific Research and Education in the Air Force" (AFASES®), 23-25 mai 2013, Braşov, pg. 372-375 www.afahc.ro/.../Cioruta_Coman_Matesan.pdf

Gunther O., 1998, Environmental Information Systems, Springer, Berlin

Hilty L.M., Page B., Radermacher F.J., Riekert W.F., 1995, Environmental Informatics as a new Discipline of Applied Computer Science. In Avouris, N., and Page, B. (Eds.). Environmental Informatics: Methodology and Applications of Environmental Information Processing, Boston

Hreniuc M., Cioruța B., Coman M., 2019, An insight into the history of scientific concerns about soil pollution in Maramures County, Journal of Documentation, Research and Professional

Training (ProEnvironment®/ProMediu®), vol. 12, nr. 38, pg. 142-149, Print ISSN: 1844-6698, Electronic ISSN: 2066-1363 http://journals.usamvcluj.ro/index.php/promediu/article/view/13643/11231

Mesaroș M., Cioruța B., Coman M., 2018, Protected natural heritage on the route from philosophy to environmental engineering, Scientific Bulletin of North University Center of Baia Mare, Baia Mare, vol. XXXII, no. 1, pg. 63-72

Kamran M., Anjum M., Rehman M., Ahmad H. and Kamran M.A., 2016, Classification of Information Systems in E- agriculture: A Mapping Study, International Journal of Computer Science and Information Security (IJCSIS®), vol. 14, no. 9, pg. 1043-1077. www.academia.edu/30688646/Classification_of_Information_Systems_in_E_agriculture_A_Mapping_Study