ADVANTAGES IN USING *GIS* FOR THE MANAGEMENT OF WASTE *IT&TC* EQUIPMENT

Michaela Dora Mihăilescu[1], L. Dăscălescu[2], Al. Iuga[3], R. Beleca[3]

Le papier analyse les perspectives d'utilisation des systèmes d'informations géographiques pour faciliter la gestion des déchets d'équipements électriques et électroniques, notamment de ceux provenant des produits informatiques ou de télécommunication. Ce travail a été stimulé par les efforts législatifs faits par l'Union Européenne et par la Roumanie afin de contrôler et de réduire les quantités des déchets ultimes, ayant comme but la protection de l'environnement. La surveillance des sources de déchets, la distribution géographique des producteurs et des centres de collecte, le routage des moyens de transport des déchets, la gestion des matériaux obtenu après recyclage ne sont qu'une partie des points d'intérêt de la mise en place des *SIG* dans ce domaine. Le papier discute dans cette perspective les avantages multiples de la démarche *SIG*.

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Selective collection of waste electric and electronic equipment (*WEEE*) is a main goal of the European and national legislative organisms, aiming to eliminate the hazardous materials, as well as to collect and recover the recyclable materials, in view of environment protection. The main responsibilities are to be charged to the producers of electric and electronic equipment (*EEE*) and the local administrations. The use of geographic information systems (*GIS*) is approached from the perspective of its application to *WEEE* management, particularly for the waste resulted from information technology and telecommunication equipment (*IT&Tc*).

1. COLLECTING AND PROCESSING *WEEE*

Recent studies in *WEEE* domain [1,2] approach the theme from the perspective of the terms imposed on European and national level with respect to the responsibilities and the methods to apply for the waste recovery and recycling.

The European Parliament and the European Council issued directive no.2002/96/EC with the following objectives [3]: (*i*) reduce waste arising from *EEE*; (*ii*) encourage separate collection and subsequent treatment, reuse, recovery, recycling and safe environmental disposal of *EEE*; (*iii*) improve the environment performances of all operators

[1] *ArchDesign, Cluj-Napoca, Romania.*
[2] *University of Poitiers, France*
[3] *Technical University of Cluj-Napoca, Romania*

involved in the life cycle of *EEE* (producers, distributors and end-users) and specially the economic agents directly involved in the processing of *WEEE*. Directive 2002/95/EC adds severe restrictions on the concentration of certain hazardous substances in new products [4].

The above-mentioned directives are transposed into Romanian legislation, as governmental orders [5,6]. At the same time, the Ministry of Water and Environment, as well as the Ministry of Economy and Commerce have subsequently issued special orders to rule the way these decisions are put into practice [7,8].

Thus, according to the requirements of HG 448/2005, *EEE* Romanian producers are obliged to support the establishment of at least one collection center in each county, and at least one collection point in each town with over 100.000 inhabitants. Until the end of year 2006, one collection center must be established in each town with over 20.000 inhabitants. The local administrations should set up locations for the collection centers and have direct responsibilities in collecting *WEEE* from household end-users. The final goal is an average waste collection rate of at least 4 kg/inhabitant/year, until the end of year 2008.

Taking into account the direct responsibilities of the producers, they have been registered at the National Agency for Environment Protection, getting unique identifier numbers that give them the right to trade *EEE*. Thus, the origin of a product is controlled in view of managing it after the end of its use period, when it becomes a *WEEE*.

2. MANAGEMENT OF WASTE *IT&TC* EQUIPMENT

According to HG 448/2005 [5], WEEE are composed of various electric and electronic equipment: large and small household appliances, IT&Tc equipment, consumer equipment, audiovisual and lighting equipment, electric and electronic tools, toys, sport and leisure equipment, medical devices, monitoring and control instruments, automatic dispensers.

Waste IT&Tc equipment represents about 10% of the total WEEE. In IT category, the main waste occur from central computer units, minicomputers, printers, personal computers (including monitors, keyboards, mice), laptop and notebook computers, actually any product or equipment for collecting, storing, processing, display and communication of data by electronic means. In Tc category, the main waste occur from used fax machines, telex machines, telephones of all types, answer machines, actually any product or equipment for sound or images or any other information transmission.

Waste from „grey products", as IT&Tc product are often called, contain metals, plastics, glass, electronic boards, hazardous materials (batteries, accumulators). Recover and recycling technologies for these materials must process them in view of reaching the recovery percentage imposed by 2002/96/EC directive (75% of the average weight and 65% of the product value).

The authors of the present paper got interested in these waste IT&Tc equipment due to a research program CEEX on the recovery of recyclable materials [9,10], financed by the Ministry of Education. The project objective is the set-up of a pilot-center near Bucharest for the recovery of waste IT&Tc equipment, one of the main phases in the WEEE processing (fig.1). Analyzing the flow chart presented in fig.1 from the GIS applicability point of view, spatial distributed entities can be identified, associated with huge descriptive databases (EEE producers, distributors, household end users, industrial end users, collection centers, treatment stations, etc.) that justify the authors' preoccupation for revealing the advantages of this particular approach.

The first issue in starting even the planning of a GIS implementation must be the establishment of the real goals of the project and identification of useful output data for the eventual beneficiaries, two requests without which such an attempt may fail [11].

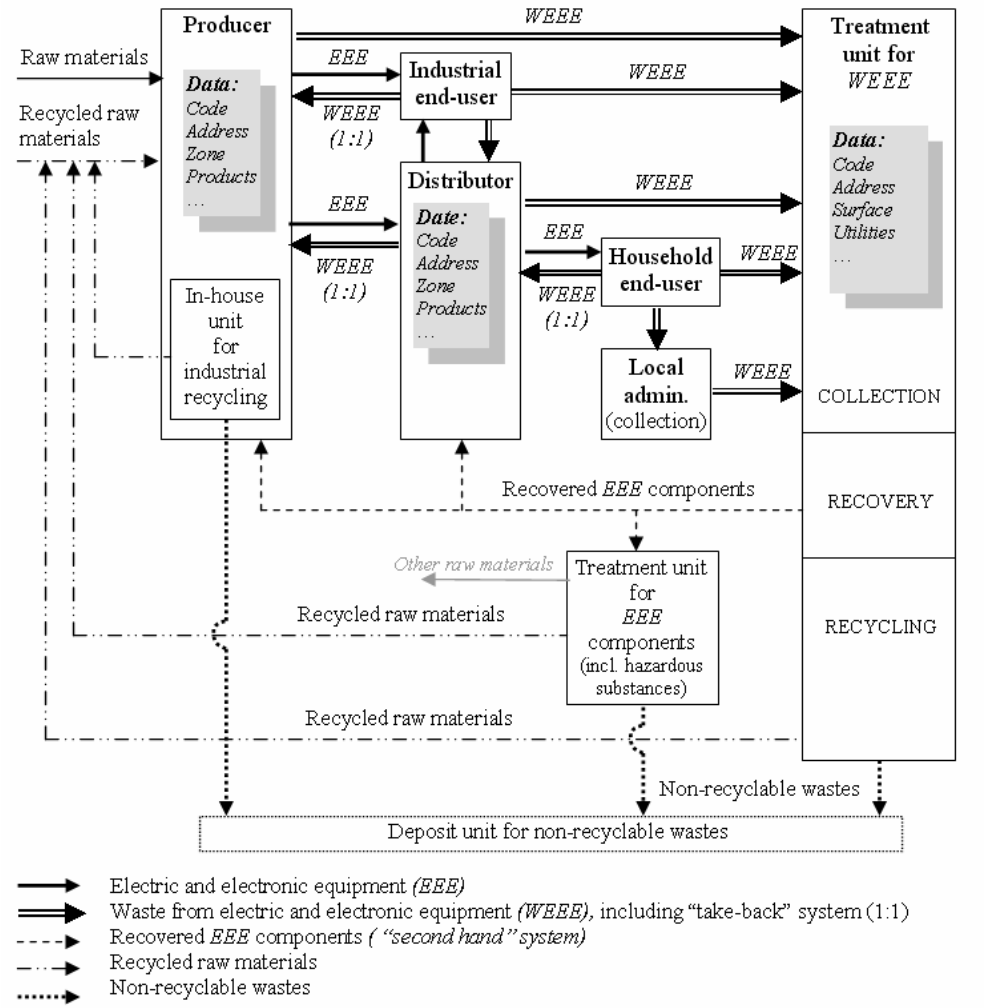

Fig.1. ***Schematic flow diagram of the electric and electronic equipment (EEE) and the correspondent waste (WEEE).***

3. *GIS* FOR THE MANAGEMENT OF WASTE *IT&TC* EQUIPMENT

GIS applications for *WEEE* management, particularly the management of waste *IT&Tc* equipment, can be ranged as "infrastructure" type. Previous studies on the *GIS* applicability in public administration [12], a domain specific for infrastructure *GIS* projects, synthetically underlines both the goals to be followed, as well as the advantages arising from implementing this *GIS* type applications.

In the particular case of the CEEX project mentioned before, the development of *GIS* applications for the management of *IT&Tc* waste is proposed. The initial goal is the facilitation of the running activities in the complex process of waste collecting and recycling. At the end, new digital information products are expected to be used in the decision process.

In order to implement a *GIS*, several steps should be carried out: analyze of the hardware and software technical specifications for each involved entity, data model design (define layers, graphical symbols, attached descriptive database structure definition, etc.), getting the input data from all available sources (local administrations, environment agencies, corporate organizations of *IT&Tc* producers, etc.), filling databases records, data validation according to field measurements. Examples presented in fig.2 and fig.3 display in graphical format the information supplied by the Ministry of Water and Environment [1], suggesting an eventual approach of the theme from a *GIS* perspective.

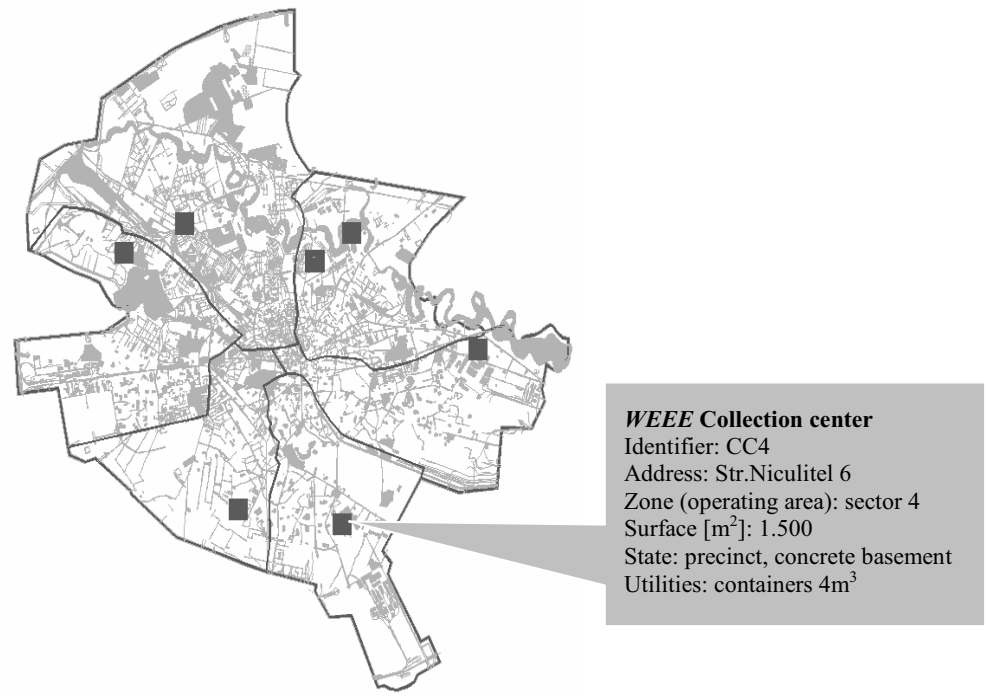

Fig.2. ***WEEE collection centers and the operating areas, geographically located (Bucharest municipality).***

The final phase offers the possibility to get reports, analyses, thematic maps, etc., as a useful support for the management level (ex: tracing collected *WEEE* from an *EEE* producer to the nearest *WEEE* collection center – fig.3).

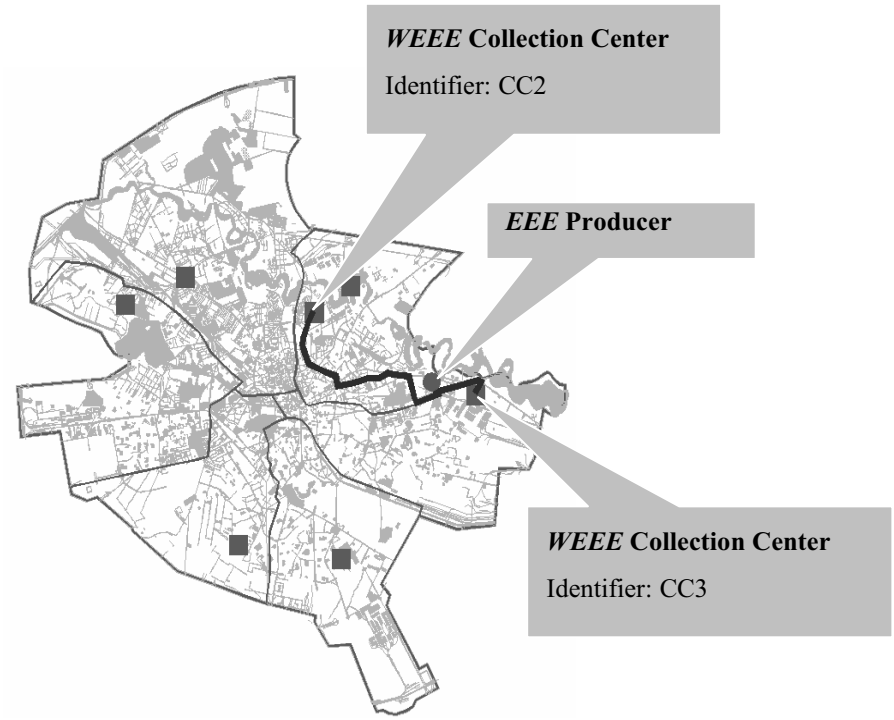

Fig.3. ***Tracing WEEE from the producer to the nearest collection center.***

The advantages in using *GIS* may be „quantified" by means of the increased efficiency recorded by the beneficiaries, both from technical point of view, as well as under financial aspects, with respect to the present management of waste *IT&Tc* equipment.

From the technical point of view, the advantages are common to most *GIS* applications, such as:

- reliability and confidence in operation
- scalability (an important advantage from the point of view of managing more numerous collection centers and waste recycling infrastructure)
- interoperability (facile data exchange between different software platforms)
- quick and intuitive access to databases
- high speed decision process
- flexibility (adaptability to changes)
- unification of data models
- increased degree of conformity between the digital data and the actual in field situations
- complex query facilities on databases, using spatial and attributive criteria, etc.

From the financial point of view, the advantages of using *GIS* are difficult to estimate without a preliminary pilot project, developed on a narrow geographical area, aiming to record in detail the costs involved in this process. Therefore, the financial aspects will become part of a further approach.

4. CONCLUSIONS

The present paper approaches *WEEE* management, in particular that of waste *IT&Tc* equipment, from the perspective of the facilities offered by *GIS*, following the typology of other "infrastructure" type applications. The idea of using *GIS* in this particular domain is a consequence of identifying geographical distributed entities, with spatial and descriptive attributes, in the data flow of the complex material recycling system.

Using *GIS* in the recovery and recycling flow of waste *IT&Tc* equipment brings benefits, due both to the efficiency and suggestiveness of spatial analyses, as well as to the accuracy, accessibility and scalability of the specific databases (graphical and descriptive).

The use of *GIS* is suggested to the *IT&Tc* producers as an alternative for superior management of their own *WEEE*. At the local administrations level, the already implemented *GIS* can be enriched with special *WEEE* modules. Spatial location of waste sources, collection routing, studying the geographical allotment of main producers and processors, tracing the recovered products post recycling are but a few of the *GIS* applicability areas identified by the authors as having certain advantages for the *WEEE* management.

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