THE ECOLOGICAL EVALUATION OF THE LANDSCAPED PROJECTS IN SOFTWARE PROCEDURE

EVALUAREA ECOLOGICĂ A PROIECTELOR PEISAGERE ÎN PROCEDURĂ SOFTWARE

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Abstract. *The urban landscape architecture and territorial establishment are ensembles with diverse functions, in harmony with the human life and the environment. Vegetation, with all its features, constitutes the bond that physically incorporates the urban buildings. In the competitions of projects proposals, the evaluation in order to select the recipient solution takes into account some factors: the implementation of the functionality criteria, aesthetical value, costs etc. An additional evaluation of the projects method, that of the ecological impact, can be accomplished digitally, by means of some subroutines created under the license of original software, through out a sequence of commands. The procedure takes into account the capacity of the species introduced in the project to reduce the level of pollutants (Pollution Removed, Tree Rainfall Interception, Carbon Storage, etc.), and the evaluation of its beneficial effect both on the human life quality and on the physiological parameters of plants (Canopy Cover, Leaf Area, Tree Condition, Leaf Biomass).*
Key words: *ecological evaluation, software subroutines, pollution removed.*

Rezumat. *Amenajările peisagere urbanistice şi teritoriale sunt ansambluri cu funcţiuni diverse, armonizate vieţii umane şi mediului, iar vegetaţia, cu toate atributele ei, constituie liantul care înglobează fizic construcţiile urbane. În concursurile propunerilor de proiect, la evaluarea realizată în vederea selecţionării soluţiei câştigatoare, se iau în calcul mai mulţi factori: îndeplinirea condiţiilor de funcţionalitate, valoare estetică, costuri, ş.a. O metodă de evaluare suplimentară a proiectelor, cea a impactului ecologic, poate fi realizată digital, cu ajutorul unor subrutine construite sub licenţa softurilor originale, printr-o succesiune de comenzi. Procedura ia în considerare capacitatea diferită a speciilor introduse în propunerile de proiect de a reduce nivelul unor agenţi poluanţi (poluanţi, cantitatea de precipitaţii captate, carbon stocat, ş.a.) şi evaluarea efectului benefic, atât asupra calităţii vieţii umane, cât şi asupra parametrilor fiziologici ai plantelor (sprafaţa coroanei, suprafaţa foliară, volumul coroanei, biomasa foliară).*
Cuvinte cheie: *evaluare ecologică, subrutine software, poluanţi eliminaţi*

INTRODUCTION

The presence of trees and bushes in urban sites where more than 80 source of pollution (Garrec, 1999), have been detected is known to have benefic effects: it ameliorates the microclimate due to photosynthesis, it reduces the ambient temperature, the amelioration of people's psychic condition (chromotherapy,

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aromatherapy), it reduces the pollution with toxic gas and suspended powders, it helps bactericidal effect, it attenuates the noise, etc. (Ulrich et al., 1991).

The choice of vegetal species for landscape use, especially trees and bushes, is a important phase of landscape projects which takes in consideration various factors: aesthetic composition, functions, adaptability to environmental conditions, growth speed, size, possibilities of crown shape, flowering period, water and nutrients needs, resistance to diseases and worms, nearby buildings, species peculiarities, etc. All these factors are important if we want to implement the concept of durative development (Konijnendijk et al., 2005).

MATERIAL AND METHOD

For a correct choice of ornamental tree and bush species used in an polluted urban ambient complex, interdisciplinary information are required, using synthetic methods that generate analytic results of landscape projects starting from the conception planning.

The Software Products, original solutions of the platforms AUTODESK and UFORE, have been used as a working base to create an integrate procedure building some functions under CAD license in Microsoft Visual Basic. This procedure is aimed to "externalize" the ecological impact. Three different tree species *(Tilia cordata, Aesculus hippocastanum* and *Prunus serotina),* were used in the experiment to measure the ecological impact on urban ambient and individual physiological parameters.

This method allows both the analysis of each tree and a cumulative analysis of the tree areas. In the end, an "ecological shaping" can be generated for every "landscape solution", that can be analyzed and modified under various parameters.

RESULTS AND DISCUSSIONS

The interaction between ornamental vegetal species and pollutant agents is considered from two perspectives: first, planting trees and bushes in urban sites helps to reduce pollution; second, we have to create conditions for plant development and chose the appropriate species for a particular site and in the same time allow trees to accomplish their aesthetic and functional purpose.

The need to measure the polluting agents and plant physiological parameters during the interaction pollution-plant-ambient-man determined the elaboration of software programs based on mathematical models. USDA Forest Service developed a software platform (McPherson, 2010) aimed to measure the annual benefits that trees and bushes bring to the ambient and life quality. This method consists in the collection of information (*Survey Information, Plot Information, Shrub and Tree Information, Meteorological and Pollution Data*) and allows a final synthesis of the situation (*Pollution Removed, Tree Rainfall Interception, Carbon Storage, Gross Carbon Sequestration, Canopy Cover, Leaf Area, Tree Condition, Leaf Biomass*) (Maco and McPherson, 2003; Xiao et al., 2000).

The elaboration of landscape projects implies drawings. We realize most of these drawings on CAD platforms (graphic and assisted projection) or, in special cases, under other licenses. We intend to use these drawings (.dwg, .dxf files) to

stock starting from the project phase some data that can generate the ecological evaluation of the potential landscape solution when imported in USDA (Maco and McPherson, 2003).

In digital drawings (.dwg files) CAD commands are used to build the entire ensemble. For vegetation in particular, the pieces are graphically suggested using predefined blocks of great aesthetical value that sometimes have the "mark" of the landscaper.

Using a friendly interface represented by suggestive icons, we created two subroutines in Microsoft Visual Basic named *PutTrees* Button and *GetTrees* Button that can be instantly activated and are represented in the same Toolbar Trees (Fig. 1.). These two commands have been used experimentally by introducing three different tree species, *Tilia cordata, Aesculus hippocastanum* and *Prunus serotina* (Fig. 3.) in CAD support.

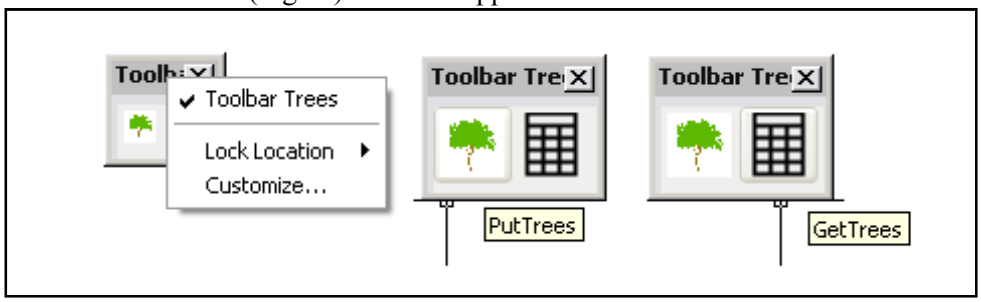

Fig. 1 - Toolbar Trees, PutTrees Button and GetTrees Button – created using Microsoft Visual Basic language

The first step in the construction of a command structure is the creation of a template file (.dwt) that must be loaded just after the opening of the CAD files. The template file contains an editable block with 33 parameters, individualized for each of the three trees: *Tilia cordata*, *Aesculus hippocastanum*, and *Prunus serotina* and structured in layers with distinct characteristics named *Tree Name*, *Project Name*, *Location/Address*, *Height*, *Crown Attributes*, *Tree/Building Energy Interactions*, *Tree Site*, (Fig. 2.). Text insertion points are localized in a table form (Fig. 3.).

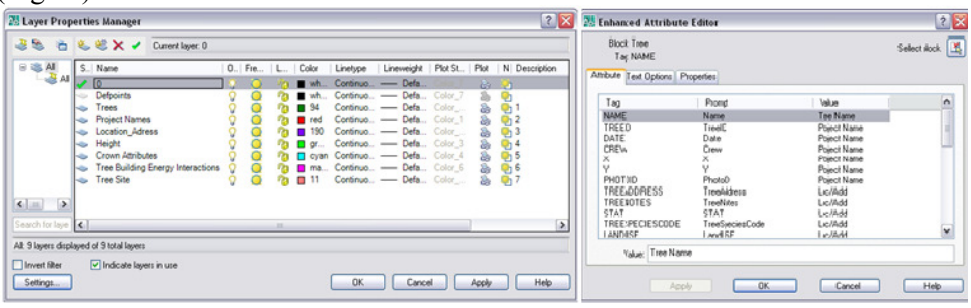

Fig. 2 - Template File Layers Structure and Dialog Box for Parameters

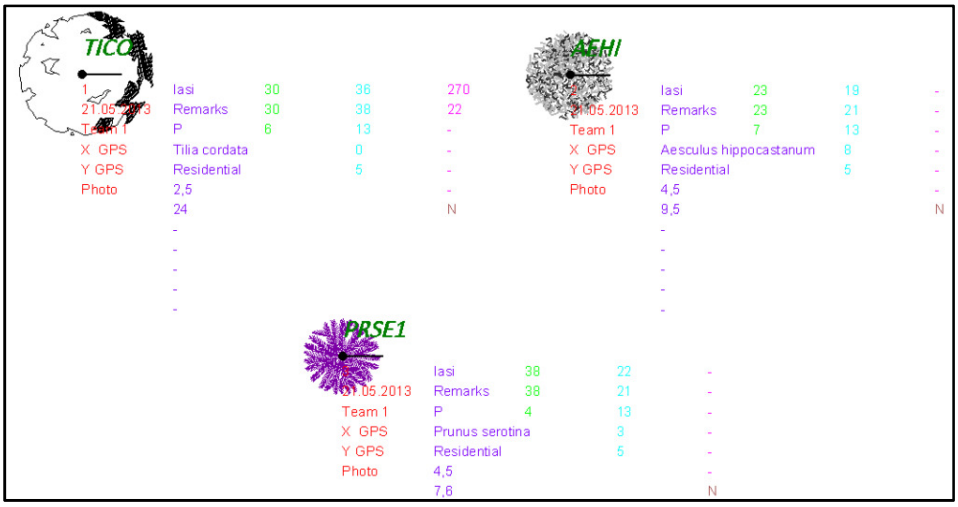

Fig. 3 - Template File Text Structure for *Tilia cordata, Aesculus hippo.* and *Prunus serotina*

By activating the *PutTrees* Button we insert in the CAD drawing space a template block with a mobile insertion point, followed by the automatically opening of a dialogue box (Fig. 2.). In the columns of this dialogue box (*Tree Name, Project Name, Location/Address, Height, Crown Attributes, Tree/Building Energy Interactions, Tree Site)* we introduce the 33 parameters for the three trees used in our experiment (*Tilia cordata, Aesculus hippocastanum* and *Prunus serotina).*

After the insertion of projection data and indices, if we activate the *GetTrees* Button we instantly generate a Microsoft Office Excel file (in .xls format) that contains all the projected parameters of the three trees that we introduced using the *PutTrees* Button in table format as a predefined structure. This format is compatible with the requirements of the USDA Forest Service ecological evaluation program.

The resulting Microsoft Office Excel file (predefined as *Trees.xls* and renamed if necessary) is the initial data base for USDA Forest Service Platform (McPherson, 2010). It will be used through data importation, as the "next step" together with the values of the parameters of pollutants and the climatic values, in order to obtain preliminary results that will be analyzed by the deciders.

The results obtained after ruling the last software platform, UFORE (Table 1. and Table 2.), reveal the different capacity of the species that we used in our experiment to reduce the level of some polluting agents (Table 2.) and the evolution of physiological parameters in the conditions that have been imposed in the projection phase (Table 1.). In this way the values can both be appreciated individually for each of the three trees used in the experiment and cumulatively in some landscape complex solutions.

Table 1.

Data Results from UFORE – Individual Tree Characteristics

Tree ID	Species Name	DBH (cm)	Height (m)	Ground Area (m^2)
TICO	*Tilia cordata*	63	15.8	98.7
AEHI	*Aesculus hippo.*	24.3	7.2	31.2
PRSE1	*Prunus serotina*	19.5	12.2	34.2
Leaf Area (m^2)	**Leaf Biomass (Kg)**	**LAI**	**C Storage (Kg)**	**Gross C Seq.(Kg/yr)**
660.48	49.47	6.61	649.34	15.42
151.09	10.57	5.18	106.35	6.6
292.59	22.69	8.67	76.91	6.08

Table 2.

Data Results from UFORE – Individual Tree Pollution Effects

Tree ID	Species Name	CO Rem (g/yr)	O3 Rem (g/yr)	NO2 Rem (g/yr)
TICO	*Tilia cordata*	14.6	652.8	125.3
AEHI	*Aesculus hippo.*	3.3	142.6	27.5
PRSE1	*Prunus serotina*	6.8	289.3	56.8
SO2 (g/yr)	**PM10 (g/yr)**	**PM2.5 (g/yr)**	**Vocs (g/yr)**	**Water Inter. (m^3/yr)**
57.9	331.2	33.9	0	5.91
12.4	81.1	8.7	0	1.42
26.6	142.1	14.3	5.47	2.63

The entire chain of commands using professional original software programs, together with created as integrated subroutines, is a consecrate method in other domains too (for example: Innovyze Products, smart wet infrastructure modeling and management tools) (www.innovyze.com, 2013), generically denominated *„simulation and modeling",* ecological in this case („Ecological Modeling and Simulation Management Solutions").

CONCLUSIONS

1. The results obtained in this experiment using three trees of three species with different individual characteristics (*Tillia cordata*, *Aesculus hippocastanum* and *Prunus serotina*) lead to different answers on the reduction of the level of urban pollution and of the evolution of physiological parameters.

2. Digital use of parameters in software doesn't affect the project conception, despite the imposed requirements. It offers perfect freedom to imagination, the virtual medium "supports" the originality, even under its abstract form, and retouch can be made in any ulterior moment.

3. The functions of created subroutines, integrated in the existing command chain, facilitate the possibility of an analysis of landscape solutions that are in

project phase, after the criteria "ecological impact", with the possibility of intervention and modification in real time of such solutions.

4. Introducing and extracting data with the subroutines that we mentioned above, and presenting them under a original, suggestive, friendly interface dedicate makes the results uniform due to utilization of the same parameters, in stationary conditions of pollution/climatic conditions.

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