Application of Electronic Data Collection in Research of Socio-Economic Importance of Forest Functions

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Abstract

The main topic of the project is the application of electronic data collection using the web interface to the research of the socio-economic importance of forest functions. A unique system for data collection, the provision of evidence and processing was designed. The system leads to the simplification of the research, to the possibility of extending the investigation in the field and to the survey of forest visit trends in the long term. The approach will enable the formation of an extended database. The paper describes the steps of the project's implementation. The e-survey started at the end of September 2010 continues to this time.

Key words

E-survey, forest functions, assessment, web development, agile methods.

Anotace

Článek se zabývá aplikací elektronického sběru dat pomocí webového rozhraní na socio-ekonomický výzkum významnosti funkcí lesa jako moderní inovativní metodou v oboru. Podstatou projektu je tvorba unikátního systému pro sběr, evidenci a zpracování dat. Vytvořený systém povede k zjednodušení administrace výzkumu. Systém umožní vznik rozsáhlé databáze a sledování dlouhodobých trendů v oblasti návštěvnosti lesa a významnosti jeho funkcí. Článek popisuje jednotlivé kroky implementace projektu. Dotazníkové šetření zprostředkované vybudovanou aplikací bylo spuštěno v září 2010 a pokračuje dosud.

Klíčová slova

E-survey, funkce lesa, web development, agilní metody vývoje, oceňování

Introduction

Forest function assessment is an important topic, discussed by scientists in the Czech Republic (CR) as well as abroad. The evaluation can be carried out in different ways. The forest functions are assessed at monetary or non-monetary value. The methods, which can be used to accomplish the monetary value of forest functions, include e.g. the *Socio-economic Valuation of Public Forest Goods and Services* according to ŠIŠÁK (2006), *Contingent Valuation Method* (*CVM*), *Travel Cost Method* (*TCM*), *Hedonic Price Method* and *Shadow Price Method*. The non-monetary evaluation can be expressed e.g. as a verbal description of the function or by adding a scale degree. The chosen technique of the assessment depends on the type of evaluation - one of the favourite methods is a questionnaire survey. A 'classical paper questionnaire' has been used in the CR so far. This type of investigation is very demanding from the point of view of the organization and it is expensive. The electronic data collection using a web interface is an innovative approach in forest function research. It might be utilized as a supplement to the existing research, however it can also be used as the main proficient method of the investigation. The paper deals with the description of the application of electronic data collection using

a web interface and its application in the socio-economic assessment of the forest's functions.

Aim and Methods

The main topic of the project was the application of the electronic data collection using the web interface in the research of socio-economic importance of the forest functions. The aim of the project was to design a unique system for data collection, the provision of evidence and processing. Input data should be analyzed through the application of mathematical methods used specifically for socio-economic relationships. The application should lead to the simplification of research and to the extended monitoring of the development in the field. It should make possible surveys of long term trends of forest visits. The approach should enable the formation of an extended database. The system thus created can be modified according to future research needs. The application will also allow the respondent's feedback, which might be a very useful tool in public education.

The project team consisted of experts from different fields (forestry, economics, informatics), who closely cooperated in the individual sequences of the work. The project work included the choice of the appropriate methods of web application development, the preparation of the structure of the web application and the creation of the questionnaire itself. Proper project management was strongly required for sufficient project's organization. The methods used for the project were chosen and the project was prepared theoretically during the year 2009. The structure of the web application was created along with the questionnaire's form in the spring of 2010. The web application was produced and tested in summer 2010. The questionnaire survey was started at the beginning of the autumn semester of 2010/2011. The survey continues up to now and will be finished by the end of the year 2010. It is expected that the research will be repeated after 1 year.

The project management was based on the use of a Pivotal Tracker. Pivotal Tracker is a simple story-based project planning tool that allows teams to collaborate and instantly respond to relevant changes. It is based on agile software development methods, but it can be used on a variety of projects. A great advantage of a Pivotal Tracker is that it is completely free, there is no software to install, and it only takes a few minutes to sign up

(PivotalTracker, 2010). The project management steps can be seen here:

https://www.pivotaltracker.com/projects/34251

Another advantage of the tool is that it is a user-friendly Internet service. The Pivotal Tracker allowed the team to get things done easily on time and to run the project smoothly.

Results and Discussion

Technological Part of Project
The choice of the used technologies was made according to the requirements of modern agile development. The emphasis was put on the methods, which are not very commonly used for programming in the Czech Republic. Most of the approaches have been used in the academic sphere for the first time.

The questionnaire system is based on a couple of building blocks. The programming language, used for the application development, is a modern scripting language called *Ruby*. All the data are stored in *MongoDB*, one of the leading *NOSQL* databases. The method which steered the project is *Behaviour Driven Development*, an agile type of the development method.

Ruby (Ruby, 2010) is an object oriented, dynamic scripting language created by Yukihiro Matsumoto. From its roots in Japan it has become one of the leading platforms of current web development. The most famous framework created in *Ruby* is called *Ruby on Rails*, however for this project a more lightweight approach was chosen, a framework called *Padrino*. The main advantage of this framework is that it is object relational mapping, javascript library and testing framework agnostic. *Mongoid*, *jQuery* and *RSpec* were chosen for relative parts.

MongoDB (Mongodb, 2010) is a document database, which is getting to be very popular nowadays. It differs greatly from the usual relational databases, used in most of the current web applications. The biggest advantage of this type of database is that it does not have any schema and therefore it is easier to change the software model without fear of breaking the link between them and underlying storage. This fact leads to the possibility of an advanced agile development. The database is written in *C++* for speed and convenience.

Behavior Driven Development (BDD) is a new agile method of analysis, development and release of software products. It is a bunch of good practices bound together based on *Test Driven Development* (*TDD*), *Extreme Programming*, *Scrum* and others. For testing purposes the *Cucumber* was used. *Cucumber* is a framework in which it is possible to write tests in a common language structured to the stories. The stories could be used as both, functional tests and documentation. (Chelimsky et al, 2010).

For story management, development velocity benchmarking, bug and feature tracking was used PivotalTracker (PivotalTracker, 2010).

The individual parts of the web development were implemented successfully according to the needs of the research. The structure of the application was the leading guideline for the programming work. The code is available as Open Source on Github service. The address is http://github.com/pepe/questionnaire, the code can be freely cloned and used.

Structure of Web Application

The structure of the web application correspondes closely to the e-survey requirements and aims of the project. The application consists of the *Front End* and *Back End*. The *Front End* includes the questionnaire and its individual parts (the introduction, the research questions = the body of the questionnaire and the conclusion). A detailed description of the single questionnaire units can be found in the Questionnaire Preparation part of the paper.

The *Back End* creates the functional body of the application and is accessible to the project administrators only. The *Back End* contains the list of questionnaires, the simple statistics and the administration part of the survey.

The list of the questionnaires serves as an the easy approach to the individual questionnaire. It supplies the information about the number of questionnaires and about the date, when the questionnaire was filled in. All the questionnaires with the detailed answers can be seen here. The questionnaires are marked numerically and with unique codes.

The simple statistics serve for the publication of the first research results. The statistics differ for the individual questions. The statistics include a computation of maximum, minimum and average

values. In the case of the questions characterized by scale answers (from 1 to 5) the statistics express the representation of individual classes numerically and in percentages.

The administration part of the system is approachable only for the registered users who login with a password. It displays all successfully filled in questionnaires, which are editable here. This page can be used for the data processing of questionnaires in the situation where follow-up research of the *PAPI* type is necessary (*paper and pen interviews*). The users can export the data file of an '.xls' type for the purposes of further analysis here. The file is fully editable using *Excel* or a statistical programmes.

The web application includes the database, which serves as a store for the obtained data and record. The database contains all the information connected to the questionnaire survey (answers, dates of filling in, unique codes of the questionnaires, comments and email addresses of the respondents). The database includes information about the numbers of respondents and about the number of questionnaires which were not completed. The size of the database is neither time nor quantity restricted, it allows the storage and recording of any amount of the data infinitely. In the case that the questions will be changed, a new original database will be created automatically. The previous and current databases will coexist as all the data from the previous database will be preserved.

The application contains '*Google Analytics*', a modern tool for web analysis. It gives us the information about the website traffic and analyzes the approaches to the website (e.g. information about place, where the questionnaire was filled in and from where the respondent approached the website, when he started to fill in the questionnaire, how long did it took to fill in the questionnaire etc.) (GoogleAnalytics, 2010)

It is evident that the structure of the application closely relates to the needs of the survey and to the form of the questionnaire. It was built with the cooperation of all the team members. The structure provides a satisfactory basis for the realization of the research's aims.. The application of the modern up-to-date approaches allows the modern analyses of the project's implementation, which enhances the project's possibilities and makes the research more valuable.

Creation of Questionnaire

The preparation of the questionnaire is a crucial point of the project. The authors took into the consideration the experience obtained during previous research in the field.

The Department of Forestry Economics and Management, in the Faculty of Forestry and Wood Sciences (FFWS) at the Czech University of Life Sciences Prague (*CULS*) carried out research orientated towards the evaluation of forest functions in 2007-2009 (*Evaluation of Socio-Economic Importance of Recreation Function of Forest in Selected Localities*). This investigation was based on a questionnaire survey performed on-site (*paper and pen type of questionnaire survey*). For the purpose of this research a large proficient questionnaire was designed. The scientists applied the experience from this research in the preparation of the current questionnaire.

The aim of the current project was to design a short and accurate questionnaire. Respondents are much more willing to fill in a questionnaire if it is short rather then if it is too long. The survey was interested in the findings concerned with the evaluation of forest visits and forest functions. The final form of the questionnaire was tested by a pilot survey on a limited group of respondents during March and April 2010. The focus group of the questionnaire included the employees and students of CULS.

The theory of questionnaire design is described by e.g. Urban (2005), Buckingham (2004) and Creswell (2003). Urban (2004) deals with the types of questionnaire and provides basic instructions about how to create a questionnaire. Buckingham (2004) and Creswell (2003) discuss the correct approach to questionnaire solutions in detail. While preparing the current questionnaire, the advice of the above mentioned authors was taken into the account. The choice of the questions considered the basic rules of questionnaire preparation. The individual questions were individually analyzed thoroughly and the questionnaire was examined as a whole unit too. The e-survey is based on a '*self-administrated*' (*self-completed*) type of questionnaire using a web interface. An explanation of how to fill in the questionnaire is attached to individual questions.

The questionnaire consists of three parts (introduction, research questions and thank-you page). The first part introduces the research study to the respondent. It explains the topic and structure of the questionnaire. It assures the respondent of the anonymity of the research.

The research questions consist of two parts. The first part is focused on the attributes of forest visits (frequency and duration of forest visits, reasons for the visits and favourite area of visits). The second part focuses on an evaluation of the forest visits and functions. The expression of the monetary value of the forest visit was based on the simplified form of the *Contingent Valuation Method* (*CVM*). The questionnaire uses both versions of the method (*Willingness to Pay and Willingness to Accept*). Šišák (1994) says that *CVM* uses, as a basis, the amount which respondents would be willing to pay for the individual forest visit (*Willingness to Pay*). *Willingness to accept* is based on the sum, which the respondents were willing to accept in the case of permanent exclusion of forest visits. If both variants are used, the results are interestingly very different (higher in the case of *Willingness to Accept*) because of the *Income Effect*. The second part of the research questions concerns the evaluation of the importance of forest functions in the CR. This part of the research is based on Šišák's approach to the diversification of forest functions. Šišák (2003) says, that the complex forest functions were not uniform from the socio-economic point of view. The functions can be divided into market and non-market forest services according to the various socio-economic demands for them. The survey uses the individual categories of forest functions based on Šišák's approach (timber production, non-wood forest production, water protection, soil protection, climatic function, health-hygienic function and nature preservation) (Šišák, 2003). The value of the individual forest functions is expressed by a scale of importance (from 1 to 5). The last question of the questionnaire focuses on the basic characterization of the respondent, it distinguishes respondents from the university (students and academic staff) and respondents from public.

The final part of the questionnaire ('*thank-you page*') contains an appreciation of the respondents' contribution. It displays the unique code of the questionnaire and allows the questionnaire to be printed. The page includes the possibility to write down the respondent's comments and an 'email window' used for future contact with the respondent in the case that the respondent would like to know the results of the research. The

respondent is informed that the email contact will be used only for this purpose.

Current State of Research

The survey focus group were the academic staff and the students of CULS Prague with the emphasis put on the students and staff of the FFWS. The survey was announced to the theoretical respondents using emails (in the case of FFWS only). The information about the research was displayed on the students' and staff intranet. The e-survey started at the end of September 2010 and continues up to now. The total of successfully filled in questionnaires was 250 by the middle of October and the number is increasing continuously. It is expected that a total of 300 - 350 questionnaires will be collected. The results of the research are not known yet, however the obtained data will be processed and further analyzed as soon as the survey is finished. It might be concluded that the project was successful so far and the project's aims had been fulfilled.

Conclusions

The application of the electronic data collection using the web interface is an important and innovative approach to the assessment of forest functions. The application leads to simplification of the research and to the extended monitoring of the development in the field. It allows the long term trends in forest visits to be surveyed. The advantage of the approach is that the investigation can be repeated periodically. The use of the e-survey is not so time and money demanding as classical questionnaire surveys. The approach enables the formation of an extended database. The data is easily editable and ready to be used in a short period of time. The system thus created can be modified according to the future research needs. Its application will also make possible to contact the respondent, which might be a very useful tool in public education.

The project included the choice of appropriate technologies, the preparation of the structure of the web application and the creation of the questionnaire itself. The project management was organized with help of an advanced management and planning tool PivotalTracker.

The choice of technologies to be used was done according to the requirements of modern agile development. The questionnaire system is based on a couple of building blocks. The programming language, used for the application development, is a modern scripting language called *Ruby*. All the data is stored in *MongoDB*, one of the leading *NOSQL* databases. The method which steered the project is *Behaviour Driven Development*, an agile type of development method.

The structure of the web application correspondes closely to the e-survey requirements and aims of the project. The application consists of *Front End* and *Back End*. The *Front End* includes the questionnaire and its individual parts, the *Back End* consists of the list of questionnaires, the simple statistics and the administrative part of the survey.

The creation of the questionnaire was based on the previous experience of the authors and followed the basic rules of questionnaire preparation. The questionnaire consists of three parts (introduction, research questions and 'thank-you page'). The research questions dealt with the assessment of forest visits by the respondents and their opinion on their evaluation of forest functions. The focus group included the employees and students of CULS.

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