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Information Support for Sustainable Tourism

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Abstract. This paper focuses on possibilities of information provision for tourists so that they can get familiar more easily with new cultures and the "unknown" environment by means of commonly known and user friendly interfaces. Each object of interest can be equipped with a wireless identification tag that can serve as: 1) Pointer to already downloaded information and thus associate it with the real object in his proper environment. 2) Link for downloading of information in real time – if a wireless communication is available. 3) Direct provider of such information – if the identification tag has sufficient capacity. 4) Provider for feedback inclusive management of tourist movement so that the communication routes are not overloaded. Information support for such kinds of tourist areas is presented. Logistic model based on Petri nets is used for simulation and life cycle assessment following Ekoindikator 99 is evaluated. Advantages of described solutions are discussed.

1 Introduction

Tourism is now a major sector of the world economy, especially as it refers to the international trade in service. Tourism´s contribution to the world gross domestic product (GDP) is estimated at some 9 %, 1 in 11 of total jobs and to more than 50 % of international tourist arrivals in Europe.

In fact, tourism output is not a simple product but, rather, a wide range of goods and services interacting to fulfil a tourist experience that comprises both tangible parts (e.g. hotel, restaurant, airline) and intangible aspects (e.g. sunset, scenery, mood) [1]. The actual purchase and consumption/production of tourist services (e.g. airline ticket, meal, admission ticket) may often be incidental to "non-market" activities, such as independent sightseeing, hiking, or sunbathing [2].

Given the predictions of an increased role of tourism industries in the world economy, the environmental aspects of, and impacts generated by tourist activities should be accurately considered according to a Life Cycle Thinking (LCT) and logistics perspective [3].

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To get a clearer, we can introduce the individual stages related to tourism using the following imagine.

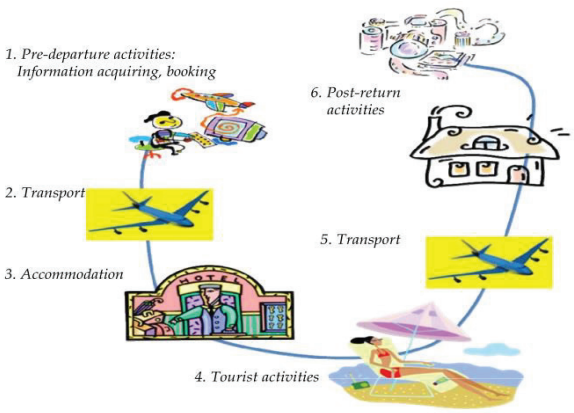

Fig. 1. Logistic point of view on life cycle of tourist. Source: [2]

Applying logistics principles the management of tourism affects the conditions of destinations and host communities, and more broadly, the futures of ecosystems, regions and nations (see Fig. 1). Logistic processes are often involved. Informed decisions at all scales are needed so that tourism can be a positive contributor to sustainable development in keeping with its role as a significant source of both benefits and potential stresses [4]. Well designed and managed tourism can make a significant contribution to the three dimensions of sustainable development, has close linkages to other sectors, and can create decent jobs and generate trade opportunities [5].

The tourism market is highly fragmented, geographically scattered and involves many and various actors along the value/supply chain: These range from a few very large tour operators (TOs) to the numerous SMEs which represent more than 95% of the organizations involved. The emergence of e-economy is a formidable opportunity for the European tourism industry to improve its competitiveness and to reinforce its sustainability. Information and communication technologies (ICT) are key enablers of a flexible response to evolving patterns of tourism and offering more attractive travel experiences, while increasing the quality and the efficiency of the value chain operations. Consumers are seeking more personalized tourism products and services, and are expecting intelligent and proactive access to relevant high quality information and services at anytime and anywhere in a mobile context [6]. ITs also transform the strategic position of organizations by altering their efficiency, differentiation, operational cost and response time. In particular, ITs have stimulated radical changes in the operation and distribution of the tourism industry [7]. This article will be focused on the use of information technology in "tourist activity" stage (holyday leisure time) and the possibility of involvement of ICT/logistics.

In the Czech Republic, there exist a lot of conceptual documents that concern issues of the sustainable development of tourism, for example the Environment in the Czech Republic, Programme for Country Revival, Regional Development Strategies, etc. This paper has rather focused on specific documents that relate directly to documents of the European Union, and also regard issues implied in the paper. Among these documents are [8-10] and others.

The sustainable development strategic framework is primarily oriented by sustainable development targets that are structured by 5 priority levels: 1. Community, people and health, 2. Economy and Innovation, 3. Regional Development, 4. Landscape, ecosystem, and biodiversity, 5. Stable Community. As regards our specific interest, the level, 3, (Priority, 3.2, Improving life quality of the populace), especially its goal, 4, 'Strengthen the

role of sustainable tourism in the structure of regional economy', because there are lot of historical, natural, and cultural preconditions for development of tourism and spa industries. There exists an extensive and well-marked network of hiking trails in the country, which implies high potential for recreation and free-time activities. Nonetheless, regarding tourism in the Czech Republic, interests of visitors concentrate mainly on the country capital, Prague. For that reason, the concept highlights the necessity of strengthening technological, innovation, and knowledge accessibility of regional potentials, which would represent prerequisites of tourism sustainable development for the whole country.

In the framework of this concept [8], SWOT analysis of current tourism trends in the Czech Republic was performed. The analysis focused primarily on the issues that are directly related to those specified in this paper. We focus on the use of logistics information technology in "tourist activity" stage (holyday leisure time) and the possibility of involvement of ICT. From our point of view following opportunities are important:

- Development of IT across the whole industry of tourism
- Further development of country and winery tourism
- Modified logistics processes and supply chain management

In parallel to the opportunities of potential development of IT and country tourism, the concept, namely item, 1.3, Improving quality of tourism services, defines individual activities that should implement the objective, specifically tourism infrastructure development (transport, guiding, IS of tourist destinations). The concept highlights the importance of tourism information provision. Currently the access to such information is rather limited in the Czech Republic, which situation should be improved in future, especially as regards regional development and regional competitiveness improvement.

Nature trails and instructive paths in the Czech Republic: The practice of hiking trail marking dates back to the beginning of the past century and was started in Germany. The principal Alpine and Thuringia trails were initially simply marked, later better distinguished by mark shape and colour. The first network of marked trails in the Beskid Mountains was developed by the Czech Hiking Clubs in 1884. Nonetheless, the systematic marking started only in 1890. Originally, the trails were marked just for simple hiking, only later, in the second half of the 20th century, nature trails, instructive paths were added. Since 1990, there have been also cycling or ski trails [11].

2 Information system support

The concept of the Internet of Things (IoT), as utilized in the field of the logistic information systems, represents new substantial innovation trend. It is possible to use its services for interconnecting equipment, various devices, sensors, action elements, control elements, servers, and people that are located in physically and topologically different places into a unified, conceptually logical whole (see Fig. 3). This concept offers completely new possibilities to the developers of information systems. Logistics of tourism is to be developed this way.

The increasingly better provisions and speed of communication infrastructure services are no longer considered as SW or HW means but they are rather taken as network services per se. This approach is usually illustrated as a cloud, from which also the term, cloud computing. The providers can offer their services easily and on a large scale including items of protection against health and safety hazards. Many of them are tailored for support of information processes in logistics of tourism.

Possible scenarios for the tourist:

1. He / she pays entry at the desk, gets the bill with identification. This identification enables his access to information system to download all information into his mobile device (smartphone or tablet) or can borrow the device with information at the desk. He

can choose proper language version. He finds information point (board, desk, or table) in the area, identifies RDID or NFC tag and gets identification of the place (QR code or simple tag stores only the location / identification). Information is displayed on the screen. See Fig. 2a.

2. He / she pays entry at the desk, gets the bill with identification. This identification enables his access to information system. He can borrow the device with information at the desk. Tourist can choose proper language version. In the area he find information point (board, desk, table), identifies RDID or NFC tag and gets full information about the place (QR code has capacity only for basic text information, tag can store more complex information with images etc.). Information is displayed on the screen. See Fig. 2b.

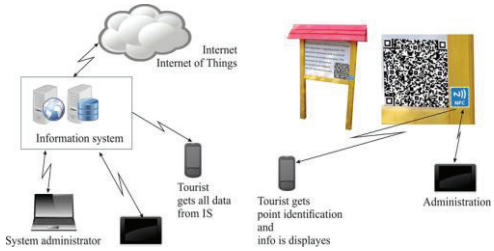

Fig. 2a. Communication infrastructure w/o internet access, without intelligent tag (unidirectional communication with tag). Source: authors

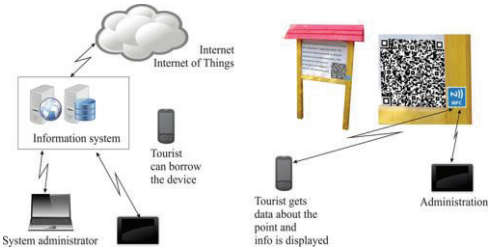

Fig. 2b. Communication infrastructure without internet access, with intelligent tag (bidirectional communication with tag). Source: authors

3. He / she pays entry at the desk, gets the bill with identification. This identification enables his access to information system via internet. Tourist can choose proper language version. In the area he finds information point (board, desk, and table), identifies RDID or NFC tag and gets identification of the place (QR code or simple tag stores only the location / identification). He gets complex information to his device. Information is displayed on the screen. See Fig. 3.
4. In case when information panel has its network connection (mostly applicable inside of buildings) important feedback can be gained in real time. This way information about number of tourists in particular points with time distribution can be obtained. It can be used for control of movement of tourists to avoid to concentrate in some places.

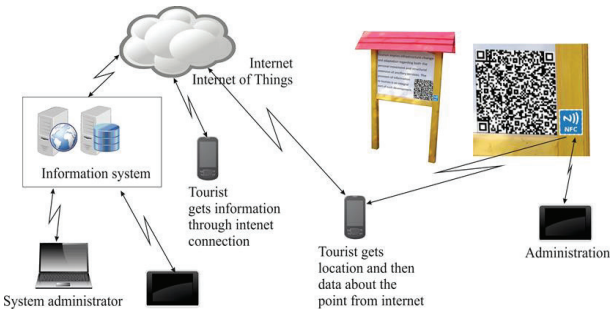

Fig. 3. Communication infrastructure with internet access (with tag and internet). Source: authors

3 Model and simulation of the load of tourist area

Introductory Reflection: People choose to go hiking in the mountains to recover from exhaustion and regain health and strength. A compact smartphone supersedes and integrates

a lot of different devices which, in the past, could make a claim to the whole space of hikers' backpacks. There are several topic we have to involve into solution:

- Geolocation - Yes or Not?
- Identifiers as Model Data Source
- Motivation to Activate Smartphone at Information Board

The presence of the information board visitors and their movement on hiking trails can be modelled [12-15] by the programme, HPSIM, for modelling of Petri nets. Here we try to use it for creation of simplified model of tourist area and use it for simulation of visitor movement. The hiker movements are simulated by movements of tokens within the Petri nets [13].

The reason for such model implementation (see Fig. 4) was in easy accessibility of data and their low time processing demand as regards subsequent graphical presentation. Another advantage is in the possibility to represent the system functions synoptically and simulate various collision situations and drawbacks before its actual application.

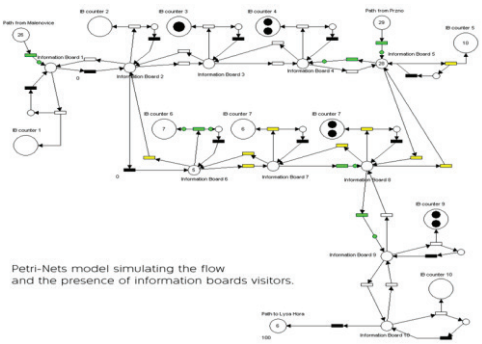

Fig. 4. Part of logistics model of the mountain tourist area used for simulation tourist area used for simulation. Source: authors

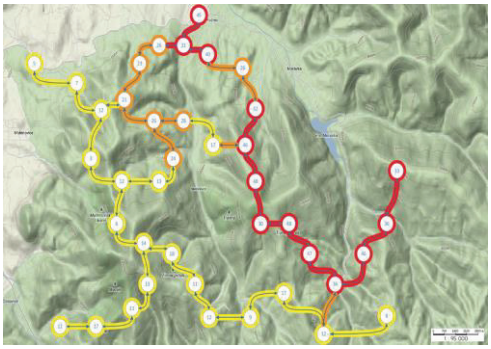

Fig. 5. Results of logistics model simulation (visitor movement in the mountain area). Source: authors

Aiming at better behaviour accuracy of the model (see Fig. 5), we decided to employ transitions (marked yellow and green in the chart) directed by exponential distribution of probability. The model gives a preferential treatment to those movement directions that are most popular as regards hiking trails of the sample landscape. Each information board has its own counter whose increments are affected by successive readings of the smartphone IDs present at the board.

The model data can be visualized by a synoptically arranged map, where attractiveness of individual information boards is colour highlighted. Yellow signifies less attractive tokens and gradually intensifying colour towards red means information board increasing popularity. In parallel to weather forecasting, intuitive perception of colour temperature is employed for the purpose.

4 Life cycle assessment

LCA is a primary analytical tool of industrial/logistics ecology, which constitutes the systematic view of local, regional, and global uses and flows associated with products, processes, and industrial and economic sectors.

The main scope of this study is a comparative Life Cycle Assessment of four possibilities of providing of information on the nature trails. Testing possibilities are following:

- providing information by a paper brochures

- providing information by an information panels
- providing information by a borrowed electronic equipment
- providing information by their own smart phone

This LCA focuses on the European markets. Therefore, the geographic boundary for the use, distribution, and disposition stages of the two systems is limited to the Europe. However, geographic boundaries for raw material extraction, material processing, and product manufacture are assumed worldwide, particularly for IT equipment.

When determining the functional units we used [14]. The fundamental unit was:

- for the paper brochure – standard A4 paper ½ printed by text and ½ printed by picture
- for the information panel – 1 information panel (equivalent amount of text and pictures as in the paper brochure)
- for the borrowed electronic equipment – 2,75 kB for printed text and 300 kB for pictures total 302,75 kB
- for the own smart phone – the same energy demands as for the borrower electronic equipment (302,75 kB) and the average energy necessary to download information

For the final life cycle inventory was used SimaPro 7.2 SW and Ecoinvent v2.1 DB.

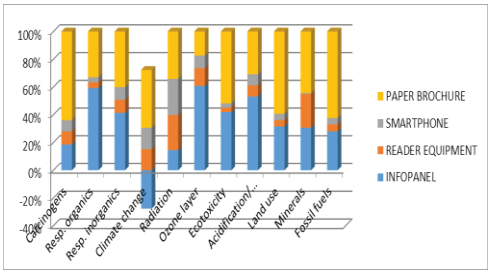

Fig. 6. Characterization of four assessed systems (midpoint category). Source: authors

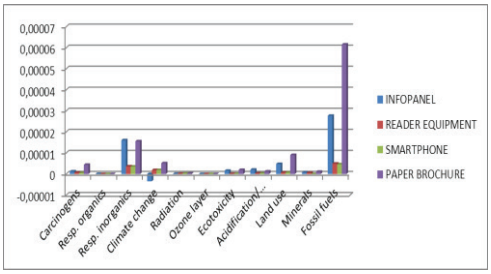

Fig. 7. Normalization of four assessed systems (midpoint category). Source: authors

Assessment of the potential impacts was made by Ekoindikator 99 method. The following charts presented the final comparison of individual different method of distributing information. Although the Ekoindikator 99 methodology is also endpoint methodology, there are presented only midpoint impact category.

The analyses performed (see Figs. 6 and 7) lead to the conclusion that printed information booklets, and also deployment of information boards are of the most detrimental effect on the distribution of information, which is both caused by high material costs of these measure realization (energy and resources needed for production of paper, steel, concrete, etc.). As regards the electronic devices of our assessment, electrical energy is of major impact (99.9 % for smartphone, 90 % for hired reading devices) as related to transfer, keeping, and visualization of data.

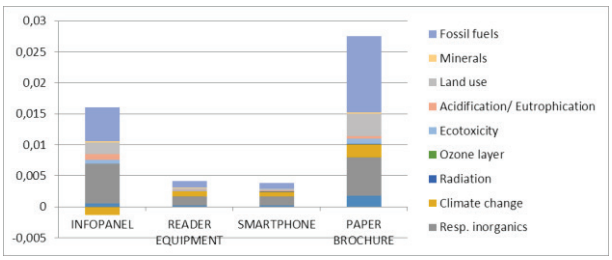

Fig. 8. Weighing of four assessed systems (midpoint category). Source: authors

For all the systems of our assessment, the consistence and uncertainty analyses were performed by the Monte Carlo method that detected calculation error does not exceed maximum limit specified (0,2 %).

The study implies especially these limitations and uncertainties: As regards paper booklets, the result is mainly influenced by the paper production method (inclusive input raw materials, as well as the way in which the booklet are dealt with after their life cycle). If electronic devices are concerned, the major negative factor is represented by taking no account of the material demands of the data storage devices (this information was not known, used estimated values), which will increase the influence of electronic devices. See Fig. 8. Although, only tentative data have been utilized, the study can maintain that, as regards electronic devices, electricity consumption and costs of data storage will constitute major impact factors.

5 Discussion

Identifiers as Model Data Source: The NFC smartphone penetration is accelerating and cannot be stopped. An option might be to equip the information board with a NFC chip, which could read a hiker's smartphone, when present at the board. The other way round, it could be also possible that a reading device within the board would read smartphone data of the hikers in the vicinity. No matter which of these possibilities is utilized, the number of visitors is counted and the length of their presence at the information board measured.

We can talk about the acceleration of the NFC smartphone penetration, but we can maintain that one hundred percent of them feature a camera. It might be more easily affordable to equip the information boards with identifiers that could be read optically. For example, it could be common bar codes. Almost any smartphone could read it and react accordingly, yielding IS input data of the same quality as would be the case of the NFC chips.

Motivation to Activate Smartphone at Information Board: Why should hikers use their smartphones in such manner that NFC or optical IDs are read. The information boards provide only static data about their surroundings. The board visitors might be motivated to activate their smartphones for reading an ID if they received some extra information better than that provided by the board itself. For example it might be an interesting video or some detailed images of the landscape. Good advice might be displayed about view preferences and individual landscape features or possible moments.

Following the provided logistics model and simulation example we can add some new "activities" to the area. For example to the effect of cross-country running, a contest oriented incentive for hikers to activate their smartphones, when present at an information board, might in a prize offered to those, who read all boards with their smartphones on the hiking trail (funicular pass discount, another bonus information, funny animations for children, etc.).

6 Conclusion

Nowadays, information systems for logistics can provide added value for tourists and for management of visited area too. The goal is to make the best condition for tourists to enjoy their stay and to get information and learn new things about the place, culture etc. Number of tourists increases every year and limits of tourist attractive place are reached or exceeded. Management of the area / place can increase logistics parameters as capacity of the place and allows more tourists to visit. Important spin-off are more working places for local people, less influence to the area. There is no necessity to develop special unique

equipment. Hardware is ready, only software – user application is to be developed and spread.

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