

# The Recommendations for Green IT Strategy Implementation in Public Sector

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**Abstract**— Adequate planning, design, introduction and use of information and communication technologies (ICT) can enable organizations to automate and speed up business processes, reduce the number of possible mistakes caused by human factors, and increase the availability of timely information. Although all of these can have a positive effect on the business, the emergence of negative effects while using modern technologies are not negligible (increased emissions of harmful gases, unplanned and uncontrolled use of non-renewable resources and energy sources, etc.). The mentioned problems caused by the use of ICT can be solved using different techniques, and one of the most popular is Green IT. By analyzing the available strategies for the implementation of Green IT, it has been established that there is room for expansion of the same, in order to more adequately meet the needs of the public sector in the territory of Serbia and Montenegro. In this paper, emphasis is placed on identifying the basic aspects of the strategy for the implementation of Green IT in the public sector, as well as providing a set of recommendations for each of these aspects. This paper will contribute to the popularization of Green IT in the public sector, and the recommendations given in it may serve as a starting point when the overall Green IT implementation strategy is created.

**Keywords:** Green IT strategy, Green IT recommendation, strategy for implementation, strategy aspects, public sector

## I. MOTIVATION

Information and communication technologies (ICT) have become integral part of business life in the public sector. They allow more efficient work and improvement of a significant number of services of importance to citizens, but often overcome the negative effects of ICT usage on the environment. For example, the study [10] foresees that in 2020 the proportion of harmful gases caused by the production and use of ICT will be 4% of the total emissions of harmful gases, which is a noticeable increase from the previous period. The estimated emissions of harmful gases caused by ICT in 2007 amounted to 2% [11]. In order to reduce the adverse impacts, the European Union has adopted the Europe 2020 strategy [12]. This act also includes the candidate countries for EU accession, before which a set of requirements are set to be met [12]. Of particular importance for this paper is the application of ICT in the public sector in the territory of Serbia and Montenegro, which also present candidates for accession in EU. The

current situation in the mentioned area is that there is little awareness of the importance of introducing and using modern ICT solutions, which at the same time will reduce the negative impacts on the environment. In addition, computer literacy in the public sector is not at an enviable level, resources are often used inefficiently (for example, non-rational printing), and the equipment in use is often obsolete (CRT monitors that are power inefficient are still in use). According to our knowledge, the aforementioned countries have not yet developed or implemented a comprehensive strategy for the introduction of Green IT. All of these incentives have influenced to explore the basic aspects of a similar Green It strategy, applicable to the described domain, as well as to provide recommendations for its implementation.

## II. RESEARCH QUESTIONS

Green IT is an approach that promotes responsible use of ICT and aims at keeping or even increasing the level of service efficiency, while reducing the negative impact of ICT on the environment. However, the ad hoc implementation of this concept cannot adequately address all the requirements and the possibilities that can be provided [1]. Local governments are mostly bureaucratic systems that have a lot of specifics in performing tasks and service provision, and therefore a strategic approach for Green IT implementation is lacking.

This strategic approach should include recommendations that would influence the resolution of all the current challenges faced by public sector employees described in the previous chapter. For the purpose of a comprehensive analysis of the necessary components of the Green IT strategy and the concretization of its recommendations, the following questions arose in the research process, which focused further course of this paper: What should the strategy for the implementation of Green IT in the public sector contain? What would be the key aspects of the appropriate strategy? Based on present situation in public sector, what would be useful recommendation for each aspect? In what time frames should this strategy be implemented?

## III. METHODOLOGY

The literature review has identified the existence of several significant strategies for the implementation of

Green IT in the public sector. Among them, the UK Strategy Greening Government: ICT Strategy [2], as well as the Green Information Technology Strategic Plan Department of Agriculture in the United States, have special importance for the implementation of Green IT in the public sector [3]. These strategies have been applied to the problem of the Green IT application in the public sector at the national level and at the level of a specific economic branch. The UK Strategy and Strategic Plan Department of Agriculture, in addition to a certain degree of generality, are related to the level of work of the Government and other national public institutions in the UK and the US respectively and to the problem of usage of ICT in order to reduce the carbon footprint accordingly. In this paper, the domain of Green IT implementation refers to the public administration sector, more precisely to the municipalities. Considering that the problem of introducing the Green IT strategy for local governments in Serbia and Montenegro contains appropriate specificities, primarily insufficient technical literacy of public sector employees, as well as passivity in the application of new technologies, for the purpose of increasing efficiency, these strategies could not be directly applied to the domain of public sector (more precisely to local government). Analyzing these strategies, we have identified common factors applicable to the described domain, but also the specificities that have to be developed for the particular region. Besides differences we mentioned, UK strategy and the recommendations we are proposing differ in the scope of institutional development, at moment of Green IT strategy implementation. Most of the public services provided by UK Government were available as e-services. Countries we are addressing are candidates to join the European Union and are obliged to develop appropriate e-services in accordance with European standards. Thus we are able to address these issues at their beginning. In addition, given that the UK was a member of the EU at the time of the adoption of the strategy, its strategy did not have to include the above-mentioned regulatory adjustments. The strategy we are proposing also differs from existing research, by extending it with two new aspects: organizational and social.

#### IV. SOLUTIONS

One of the first steps in creating the Green IT strategy is to identify key aspects. Various formulations of key aspects can be found in literature. Thus, the author [1] identifies the following basic aspects of the Green IT strategy: economic, process, human and technical, while according to the UK strategy [2] the following key aspects have been identified: Operation, Production and design, reuse and disposal. Regarding the specificity of the application of Green IT in the public sector in Serbia and Montenegro, as well as the fact that the aspects of the strategy can be treated as the main content of the recommendations of the Green IT strategy, this paper has extended the aspects of existing strategies. Additional aspects have been introduced that take into account the specificity of applying Green IT to the public sector domain, as well as the specifics of the current state of the public sector at Serbia and Montenegro. The relation of identified aspects and organizational approach can be presented as in Figure 1.



Figure 1. Green IT Strategy Aspects

The aspect of the organization is shown as the central part of the diagram, because it also plays the role of connective tissue for all other aspects. The most important recommendations for this aspect are:

- **Action plan** – Document that should further elaborate on steps to implement Green IT strategy in public sector is Green IT action plan. Action plan defines various aspects and phases in implementation of proposed recommendations. Key stakeholders should be defined as well as their role in this process. Action plan also needs to define processes that will insure implementation of Green IT recommendation; it needs to contain metrics and ways of verification. A proposed action plan that can be used to implement this strategy can be found in paper [6].
- **EU harmonized regulations** – Both Serbia and Montenegro are candidate countries to join European Union. During process of joining Europe family, both countries need to go through process of law harmonization with EU regulations. Several of these regulations greatly affect area of environment responsibility and sustainability [5][7]. For reasons previously mentioned all recommendations considered are harmonized with EU directives.

Technology represents an indispensable aspect when it comes to the Green IT strategy. This aspect contains touch points with process, but also with the HR aspect, due to employee's referral to technology. Below are recommendations for this aspect:

- **Power management** – One of aspects of Green IT approach is PC power management [13]. It is a technological mechanism for controlling personal computers hardware power consumption. It is a software that puts personal computers to lowest power demand state possible. There are several solutions available that include power management software implemented in operational systems and third party solutions such as 1E Night Watchmen, Data Synergy Power MAN or Verdiem Surveyor.

- **Web Services** - Law defines Services offered to citizens by municipalities, accordingly these services are already unified, however, there are major differences in the implementation of services from municipality to municipality. Methods of implementation and service delivery to citizens, is currently decided at the level of each municipality, and therefore there are great differences. An analysis of the state of e-Government in Montenegro for 2015, conducted by the Ministry of Information Society and Telecommunications [4], found that there is an increased number of e-services offered. However, these services are not related to the work area of municipality, although they are by the Law on Electronic the administrations were obliged to implement these services within 18 months from the date of passing the law. One way of implementing these e-services is by providing services like Web Service (WS). The main advantage of the WS in relation to classic applications is primarily the standardization, availability and independence of the platform to which it is used. These web services need to be standardized at the national level in order to provide citizens with an easier way of using them. The stated standardization of the web service itself would also provide a unique platform for the provision of these services, and thus could be implemented as private cloud computing owned by the government, which would not create the need for additional infrastructure.
- **Equipment database** -It is necessary to provide a database of all the equipment that is available to each of organizational units. Under the organizational units, we consider the ministries, local governments, public enterprises of the state and public companies at the local level. Such a database can provide an overview of redundant equipment, so appropriate procedures can be delivered for managing redundant and unneeded equipment. The state of IT equipment varies from municipality to municipality, and depends primarily on the financial resources available to each municipality. Aforementioned database will provide an overview of the state of IT equipment by individual municipality, as well as a review of needs and surpluses of IT equipment.

The aspect of the processes is one of the most important aspects for each organization. When it comes to processes that are significant for the Green IT strategy, the procurement process is, above all, separated, as a common procurement procedure in the public sector. Given that the equipment represents a significant resource of any organization that introduces Green IT, special attention is dedicated to the resource management processes, which are described below in more detail. This is also associated with the technological aspect of the strategy. Identified recommendations for the process aspect are:

- **Public procurement** - IT equipment that is purchased in the future must meet Green IT standards. In order to ensure this, it is necessary to adopt public procurement procedures that will be in line with Green IT recommendations. Public procurement of IT equipment must include as additional conditions:
  - Total Cost of Ownership metric

- Minimum energy standards that each product must meet

**Total cost of Ownership** provides insight into not only the cost of the purchase, but also the costs of owning and using IT equipment. Accordingly, equipment that has the lowest value of TCO metrics over a longer period of time will be more economical and must be given priority over others. [9] Energy Star has developed **energy standards** for equipment, in line with electricity consumption and environmental impacts that can be used. [8] Energy standard is important to consider for every procurement, but it won't be further researched in this paper.

- **Equipment management procedures:**
  1. **Equipment acquisition** – Needs on acquiring new equipment should be based on created database of IT equipment we mention in technological aspect of this strategy. Acquisition of new equipment should be done according to public procurement procedure previously described
  2. **Equipment reuse** –Established surplus of equipment should be reused within organization where possible. Where this isn't possible procedure for equipment transfer between municipalities should be made in order to use existing equipment to its full extent. This will avoid additional procurement and help better management of equipment.
  3. **Equipment donation**– Where equipment reuse as procedure isn't possible, and IT equipment is no longer in requirement, equipment should be donated to, either NGO or people in social need to avoid additional costs and impacts of equipment disposal.
  4. **Equipment disposal**– Last procedure within equipment management should be how to dispose unneeded equipment. IT equipment should be disposed with accordance to The Waste Electrical and Electronic Equipment Directive. [5]
- **Reengineering** – The work of municipalities in Serbia and Montenegro is defined in detail by legal frameworks, but implementation of processes is outdated. Several aspect of day to day processes should be reengineered. **Internal communication** in municipality is still primarily based on the use of paper, classical reports, write-ups and letters. This kind of communication has several negative impacts on environment and should be changed. Use of mail service and e-documents in internal and external communication should be encouraged and promoted. **Document archiving** is performed in classical manner with hard paper copies, this kind of documenting consumes a great amount of space. We recommend to replace old fashioned style of archiving with electronic archiving in order to save space and ease search for specific and required documents. If these two processes are reengineered appropriate procedures should be made. **Video conference** represents another recommendation in order to reduce traveling expenses, and directly influence carbon footprint as result of excess travel. This process allows us to decrease carbon footprint by using ICT.

The aspect of human resources, especially in domain of municipalities in Serbia and Montenegro for the reasons mentioned in chapter 3 should be given special attention. The human factor is crucial for the realization of the mentioned strategy, because processes and technologies

are dependent of this aspect. Through education of employees this aspect achieves a connection with the social aspect, while the training of employees establishes the connection with the technological aspect of the strategy. This aspect deals with the training and education of employees, as well as the mindset that we want to encourage among employees in public administration:

- **Education** –We recommend that employees should be educated about negative impacts of everyday work. Raising awareness about negative impacts of everyday processes can help employees to understand importance of their reduction. Finally, employees need to be educated about Green IT approach and its benefits.
- **Training** – Responsible usage of IT equipment carries an important role towards reducing negative impacts, energy consumption and carbon footprint. Training employees to use IT equipment in accordance with Green IT approach is one of recommendations. Use of personal computers, printers, and printing as process should have focus of this training.
- **Equipment usability** – Usage of consumables mainly paper, and power consumption should be monitored. Unnecessary printing should be monitored and discouraged in order to reduce paper consumption. Affecting this problem will decrease both power consumption due to less usage of equipment and paper consumption for same reasons.
- **Green mindset in general** – Being environmentally responsible, committing to Green IT and other responsible and sustainable practices, in general, should be aimed within employees and should be categorized as desired state to achieve.

Because of specificity of applying Green IT in the public sector, i.e. in municipalities, the need for inclusion of a social aspect has emerged, which is not frequent in other strategies. This aspect provides support to customers, end-users of the System, and provides basic recommendations for easier adaptation of clients to the effects of applying Green IT:

- **Raising awareness** – Negative impacts of using ICT should be also present in society. Municipalities can raise this issues among their citizens. Individuals should be aware of negative impacts of their everyday ICT usage.
- **Promotion** – Implementation of Green IT strategy should be promoted to citizens, in order to raise awareness and influence change. Environmental responsibility should be shared by everyone that interacts with municipality and everyone can contribute.

- **Education** –E-government is a new service, it can ease a lot of processes and services required by citizens, but also can cause confusion. Implementing new technologies should be followed by education of citizens, in form of user manuals, pamphlets and radio and television shows to better explain new possibilities.

With our strategy we want to achieve changes in the technical and organizational sense. These recommendations, apart from being classified according to the aspects that we have defined, can be diversified according to the approach to implementation. Within the strategy, the following approaches to the implementation of recommendations can be identified:

- **Reactive activities** represent the immediate response to the existing situation. Mechanisms are primarily reflected in the implementation of technical solutions that will contribute to the realization of Green IT recommendations and goals.
- **Proactive activities** are focused on long-term changes in the organizational and operational sense. They need to provide a change in the way of thinking. In addition, how to organize business processes, so that they are in harmony with the Green IT approach.

Both the reactive and proactive approach to recommendations aim at reducing the negative effects of the application of Information Communication Technologies as well as reducing the negative effects on the environment that are created by other local government processes. The basic difference between proactive and reactive views is in approaching the mentioned problem.

Each of the above recommendations, given for the appropriate aspect can be classified either in the category of proactive or in category of reactive. In order to facilitate the planning of the implementation we introduce, a time dimension that is divided into two segments.

The first represents a short-term segment and includes a period of the first two years from the moment of defining and starting the implementation of the strategy.

The second refers to a time period of two to four years from the moment of defining and starting the implementation. A period longer than four years is not covered by this strategy. The reasons for this are found in the frequent trend of changes in ICT and the exploitation of the full potential of the proposed strategy.

TABLE I.

Two dimensional segmentation of recommendations

	SHORT TERM	MIDTERM
REACTIVE	<ul style="list-style-type: none"> <li>• Power management</li> <li>• Equipment usability</li> </ul>	<ul style="list-style-type: none"> <li>• EU Harmonized Regulations</li> <li>• Equipment management</li> </ul>
PROACTIVE	<ul style="list-style-type: none"> <li>• Equipment database</li> <li>• Raising Awareness</li> <li>• HR Education</li> <li>• HR Training</li> </ul>	<ul style="list-style-type: none"> <li>• Action Plan</li> <li>• Web services</li> <li>• Promotion</li> <li>• Social Education</li> <li>• Green Mindset</li> <li>• Public procurement</li> <li>• Reengineering processes</li> </ul>

For easier tracking, the table gives recommendations for the implementation of Green IT in the public sector in a two-dimensional view. Dimensions include the approach to implementing the recommendations and the timeframe.

## V. CONCLUSION

Implementation of information technologies in the public sector in Serbia and Montenegro is at the very beginning. With the timely implementation of the Green IT approach, sustainable information systems can be created, which can significantly reduce the costs of maintaining and using these systems. The Green IT recommendations need to be addressed in a systematic way, because two of the major obstacles to their implementation are insufficient training of employees in the use of information and communication technologies, and great resistance to innovations. Besides human resources, aspects of interest for implementation of Green IT recommendations are organizational aspect, technical aspect, social aspect as well as business processes aspect. Because of this, our strategy gives a special overview of employee training, as well as training of service users in order to minimize these negative aspects. Existing strategies primarily deal with technical and technological aspects, and therefore do not take enough of human factor in implementation. The proposed strategy provides one of possible approaches to the implementation of green IT recommendations because it takes into account the specificity of our area. These strategies provide recommendations for the development of information systems, which should be sustainable, the application of which should not represent the problem of employed personnel and whose application should provide better service to citizens. Further development of the strategy should include an action plan that will concretize the recommendations, and provide benchmarks for monitoring the success of the implementation of the strategy.

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