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Towards a sustainability audit process model for ICT organizations using GaiaTool

Hacia un modelo de proceso de auditoría de sostenibilidad para organizaciones TIC utilizando GaiaTool

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ABSTRACT
Information and Communication Technology (ICT) companies play an important role in sustainable development. Although their operations and products can have negative environmental impacts, they also hold significant potential as enablers of sustainability across various sectors. In this context, the generation of sustainability reports offers ICT organizations several benefits, such as a systematic approach to sustainable practices, guidance for implementation, evaluation criteria, improved communication with stakeholders, and potential reductions in environmental footprints. This paper introduces a process model for auditing sustainability which is being tailored to ICT organizations. The proposed workflow has been automated through GaiaTool, a novel sustainability audit tool designed to assess the sustainability level of organizations by evaluating their business processes using a set of reusable sustainability indicators. GaiaTool enables automation of the audit process and facilitates collaboration among auditors. Currently, validation is being conducted with 27 experts from ICT organizations by using the Technology Acceptance Model. This work contributes to the field of Green Business Process Management (Green BPM) audits as GaiaTool generates comprehensive reports with sustainability metrics and supports continuous improvement by identifying areas for enhancement.

Keywords: sustainability; sustainability indicators; business processes; GaiaTool; sustainability audit.

RESUMEN

Las organizaciones de Tecnologías de la Información y la Comunicación (TIC) desempeñan un papel importante en el desarrollo sostenible. Aunque sus operaciones y productos pueden tener impactos ambientales negativos, también poseen un gran potencial para promover la sostenibilidad en diversos sectores. En este contexto, la generación de informes de sostenibilidad ofrece a las organizaciones TIC varios beneficios, tales como un enfoque sistemático hacia prácticas sostenibles, orientación para su implementación, criterios de evaluación, mejora en la comunicación con las partes interesadas y posibles reducciones de su huella ambiental. Este artículo presenta un modelo de proceso para auditar la sostenibilidad, el cual está siendo adaptado a las organizaciones TIC. El flujo de trabajo propuesto ha sido automatizado mediante GaiaTool, una innovadora herramienta de auditoría de sostenibilidad diseñada para evaluar el nivel de sostenibilidad de las organizaciones mediante la evaluación de sus procesos de negocio utilizando un conjunto de indicadores de sostenibilidad reutilizables. GaiaTool permite la automatización del proceso de auditoría y facilita la colaboración entre los auditores. Actualmente, la validación se está llevando a cabo con 27 expertos de organizaciones TIC utilizando el Modelo de Aceptación Tecnológica (TAM). Este trabajo contribuye al campo de las auditorías de Gestión de Procesos de Negocio Verde (Green BPM), ya que GaiaTool genera informes completos con métricas de sostenibilidad y apoya la mejora continua al identificar áreas de mejora.

Palabras clave: sostenibilidad, indicadores de sostenibilidad, procesos de negocio, GaiaTool, auditoría de sostenibilidad.

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Introduction

Information and Communication Technology (ICT) organizations have two important roles to play in the context of sustainable development. On the one

hand, significant environmental effects are produced by their operations and the growth of their goods and services, such as high energy use, a rise in the production of e-waste, and a need for natural resources to produce hardware [1], [2], [3]. On the other hand, ICT is also becoming a major force behind sustainability across several organizations. Digital technologies and innovative solutions are critical for optimizing resource management, improving environmental monitoring, accelerating the transition to renewable energy, and promoting circular economy models. The adoption of these digital solutions has a positive impact on sustainable development as it enables more sustainable, efficient and effective processes across multiple sectors, operating as an enabler to achieve many Sustainable Development Goals (SDGs) [4], [5].

Sustainability audits are required for evaluating and confirming how well businesses are performing in respect to their sustainability goals and pledges [6], [7]. A sustainability audit is a regular evaluation of a sustainability program with the goal of identifying areas for improvement and tracking advancements made towards sustainability. According to Ananda et al. [8], these audits can assist in identifying activities, enhancing planning, encouraging accountability at all organizational levels, and promoting a rigorous approach. The automation of audit processes using information systems is recognized as an important component of sustainable auditing for organizations that heavily rely on technology, such as ICT organizations. Undoubtedly, the auditing process will benefit from having automated support, as it helps reduce the time required to carry out the audit [7]. Although Coyne [4] identified a set of guidelines, principles, and standards for sustainability audits, to the best of our knowledge there are no specific guidelines tailored to ICT organizations, nor are there any that comprehensively address all dimensions of sustainability, including the individual and technical dimensions.

This paper aims to present an ongoing process model for auditing sustainability which can be of particular interest to ICT organizations. The process is being automated through a software tool named GaiaTool. GaiaTool is intended to become a sustainability auditing tool that helps decision-makers assess an organization's sustainability level using a set of quantitative indicators related to the organization’s business processes. The remainder of this contribution is organized as follows. A summary of related work regarding sustainability audits is provided in Section 2. The proposed process model for auditing sustainability and the supporting tool is covered in Section 3. Finally, Section 4 presents the conclusions and potential avenues for future research.

Related word

There are several tool proposals in literature which have been developed either to assess sustainability or to support the generation of sustainability reports. Sustainability audit tools allow organizations to select, collect and automate the reporting process, facilitating communication with stakeholders, reducing their carbon footprint and preserving resources, thus reducing the cost and time of the audit process. Čuček et al. [10] analyze eleven web applications to assess sustainability in organizations. These applications enable the calculation of a sustainability index according to various criteria including carbon, water, land, ecological, economic, financial and social aspects in the organization. More recently, Shoturma [11] examines the current state of sustainability reporting services in ICT companies. This work analyses seven ICT organizations that have implemented tools to provide services related to sustainability reporting. The main gap detected in this work was that it is necessary to define different types of reports depending on the stakeholders' needs. Moreover, the sustainability indicators or KPIs must be adapted according to the standards, frameworks, and requirements used by companies such as GRI, EU Taxonomy and GHG Protocol (Greenhouse Gas Protocol).

Grecu et al. [12] develop a software application to assess sustainability in organizations by using a mathematical model to assess sustainability indicators and allowing the generation of a sustainability report with a single indicator named Global Sustainability Index (GSI). Besides, Silvast et al. [13] conducted a case study using the B Impact Assessment tool created by the B Lab with the aim of obtaining benefits and challenges from measuring business impacts in a small-sized business. In this line, GaiaTool provides a novel perspective starting from business processes, aiming (1) to evaluate the so-called sustainability level of the organization through a multi-criteria analysis of sustainability indicators gathered in a repository; and (2) to generate sustainability reports that suggest improvement proposals as outcomes of the auditing process.

Methods

Auditing sustainability with GaiaTool

Audit process model

This section describes a process model for auditing sustainability in an organization based on sustainability indicators. Also, the audit process model was developed drawing upon the Gaia method proposed by Sobrino et .al [14].The workflow has

been designed following the five main audit stages previously identified by Fraser et al. [13]. Figure 1 illustrates the sequence of activities involved in auditing sustainability using GaiaTool:

- **Audit planning**: this activity starts when the chief auditor analyses the strategic projection and stakeholder's requirements of the organization that will be audited. A sustainability indicators repository is reviewed to select the indicators that will be assessed during the audit process. The selection of the most suitable indicators depends on the type of organizations and how the dimension of the Karlskrona Manifesto [16] will be considered in evaluating sustainability indicators within business processes. This activity produces a planned audit calendar, an estimated audit cost and a list of sustainability indicators to be used for evaluation.
- **Audit execution**: in this activity the businesses processes of the organization are assessed by the auditors based on the sustainability indicator list defined in Audit planning activity. Each sustainability indicator is evaluated using its corresponding formula, which may be either qualitative or quantitative. In particular, the process sustainability index is calculated by using the Saaty's method [17]. This index is a quantitative measure of a process' level of sustainability based on the sustainability indicators defined by the audit team. Once the sustainability indices of the business processes have been determined, the sustainability coefficient of the organization is then determined. This coefficient is derived from the weighted sum of the sustainability indices divided by the total number of processes within the organization. The assessment process allows for comparison with benchmarked values, which are formally established as reference levels for each indicator.
- **Audit report generation**: this activity involves reporting the sustainability indicators assessed for each business process and documenting the evaluation results obtained in the previous step. The sustainability audit report includes key details such as audit name, organization name, chief and evaluator auditor names, audit deadline, audit description, process sustainability index, sustainability indicators assessed, and measurement results.
- **Organization improvement**: business processes and especially those that received the lowest scores during the audit process should be improved. Then, a re-evaluation of the sustainability indicators in Activity 2 is performed. At this stage, it is crucial to analyze the quality of the indicators and verify whether appropriate measurement methods were used for their

evaluation. A sustainability improvement plan should be designed which encompasses a set of recommendations to foster the progress of the coefficient of sustainability.

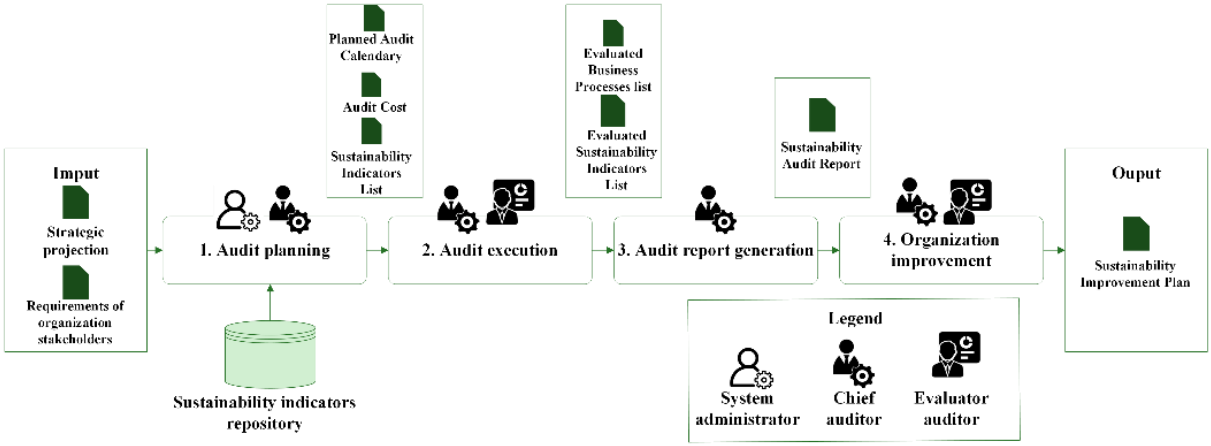


Fig. 1 – Activities in the sustainability audit process supported by GaiaTool.

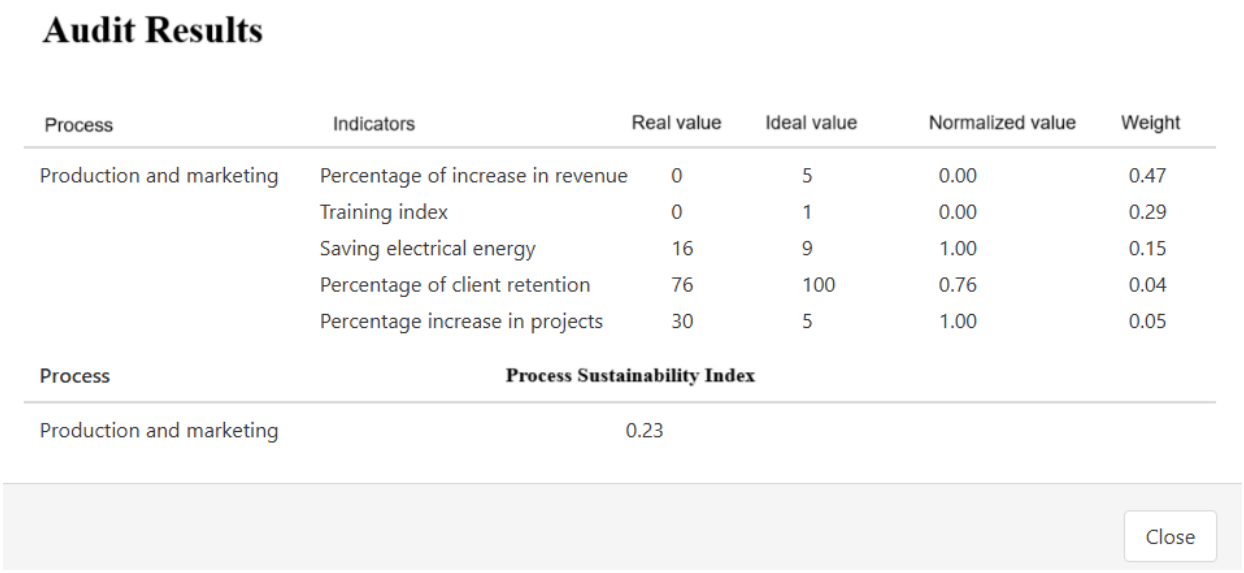
Results

This section outlines how a sustainability audit can be carried out using GaiaTool. The automated audit process involves the participation of a chief auditor, together with a set of evaluator auditors and a system administrator. GaiaTool supports two types of audits, internal and external, considering whether the audit team belongs to the organization or not.

Sustainability audit using GaiaTool

The audit process begins when the chief auditor: (1) registers the organization to be evaluated. GaiaTool allows users to create, edit, and delete organizations; (2) defines or reuses the sustainability indicators to be assessed; (3) defines the business processes of the organization. Each business process is then associated with a set of sustainability indicators, and each sustainability indicator is related to some Critical Success Factor; and (4) creates the audit and evaluates the set of sustainability indicators introduced earlier. GaiaTool supports the creation, deletion, viewing, editing, closing and reopening of audits. When creating an audit, the sustainability indicators are evaluated in the business processes (see Fig. 2). GaiaTool facilitates collaboration among multiple auditors working on a single audit.

Once the sustainability evaluation is completed, the tool provides statistics and allows the generation of reports. Some of the statistics include the process sustainability index, the organization's sustainability trends over a specified period, and the organization's sustainability coefficient by year. Once an audit is selected for report generation, the chief auditor is provided with a link to download the report.



Audit Results

Process	Indicators	Real value	Ideal value	Normalized value	Weight
Production and marketing	Percentage of increase in revenue	0	5	0.00	0.47
	Training index	0	1	0.00	0.29
	Saving electrical energy	16	9	1.00	0.15
	Percentage of client retention	76	100	0.76	0.04
	Percentage increase in projects	30	5	1.00	0.05

Process	Process Sustainability Index
Production and marketing	0.23

Close

Fig. 2 – Evaluation of sustainability indicators in the business process.

Conclusions

This study presents a process model for auditing sustainability in organizations which is currently being implemented through GaiaTool, a tool that aims to provide automated support for assessing sustainability indicators. GaiaTool has been designed to calculate sustainability coefficients and generate sustainability indices for each business process, thus enabling organizations to monitor their sustainability performance and support continuous improvement.

A validation study involving 27 experts from ICT organizations is currently being carried out to evaluate GaiaTool. It is expected that specific guidelines and relevant indicators will be identified for this type of organizations to better fit the audit process to their particular needs. The Technology Acceptance Model (TAM) will be used as the framework for this evaluation. As part of future work, we propose developing an AI-based computational algorithm to assess an organization's level of sustainable development. This algorithm should incorporate indicators normalization, prioritization through machine learning techniques and the

generation of personalized recommendations. These capabilities are expected to help identify key areas for improvement and promote sustainable practices across economic, social, environmental, individual, and technological dimensions.

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Conflict of interests

The authors declare there is no conflict of interests.

Author's contributions

Raimel Sobrino Duque: Article conception. Definition of audit business model to be performed. Execution of the audit process with GaiaTool. Writing the research results. Preparation of graphs and tables. Editorial review.

Juan Antonio Plasencia Soler: Article review. Methodological guide for identifying the audit business model steps to be conducted. Editorial review. Review of the study's methodological rigor.

Begoña Moros Valle: Article conception. Methodological guide for identifying the audit business model steps to be conducted. Editorial review. Translation of the manuscript containing research results.

Joaquín Nicolás Ross: Article conception. Methodological guide for identifying the audit business model steps to be conducted. Editorial review. Translation of the manuscript containing research results.

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