

ICT sustainable management: towards a better alignment with the sustainable development strategy

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Abstract

The impact of Information and Communication Technologies (ICT) in terms of Sustainable Development (SD) has led to a great transformation in business management, which positions innovation as an essential element of differentiation for the new market conquest. These ICT, that are particularly adapted, allow creating value for the company in a sustainable way and more aligned with the global SD strategy while ensuring to bring competitive advantage and anticipate new economic, social and environmental problems. To implement an innovation approach that gives organizations the means to develop sustainable management strategies, allowing them to increase overall performance, we proposed the "ICT Sustainable Management" model which is designed according to a Green IT (GIT) and Corporate Social Responsibility (CSR) concepts in order to seek new transition ways for management serving SD. Our model constitutes a first research step to lead reflection on next-generation SD-oriented management models. For this reason, we consider it more appropriate to approve the validity of our model through its application on different categories of companies that use ICT. Analysis of the results of this application test has demonstrated the validity of our model at the scale of five companies. This initial validation will be supported by improvements and new tests that will be extremely useful to improve the model and to advance knowledge in this new field of research.

Keywords

Corporate social responsibility, Green IT, Information and communication technology, Sustainable management.

1.Introduction

In an increasingly complex and interconnected world, organizations are facing new challenges that represent social, economic and environmental issues. In this context, Sustainable Development (SD) became a real business strategy for large majority of companies. It represents a new opportunity for innovation and development of their business in new markets. Finding a balance between economy, society and environment requires implementing changes at the strategic level, particularly at the business model level [1]. The use of Information and Communication Technologies (ICT) helped organizations to develop their business and thus perpetuate progress.

These organizations are therefore invited to exploit sustainability potential offered by these ICT in cooperation with all stakeholders. Sustainability is a very important economic, technological and environmental issue that affect design and development of new products and services through environmental and societal compliance, cost minimization, branding and reputation requirements and value creation. Organizations could therefore come closer to society if they redefined their goal of creating shared value that generates economic value in a way that also produces value for society and the environment [2]. The increasing attention given to SD and more specifically to Corporate Social Responsibility (CSR) in field of ICT management encouraged researchers to incorporate sustainability for implementation of management models, in order to facilitate organizations gain in competitiveness

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while respecting environmental and societal constraints of stakeholders.

In recent years, influence of ICT use whether on society or on environment has been the subject of many studies. Thus, the dynamism and complexity of management approaches have forced many authors to focus on the problem of integrating SD into all management processes [3], but also at the level of decision-making in overall strategy of organizations. This perspective must therefore be systemic to strengthen the link between the design and the use of these SD-based management models. Some authors show that sustainability concept should be integrated into the overall business strategy [4], and therefore the implementation of the SD or CSR strategy in the ICT management strategy must not be considered as an independent issue. Economic, societal and technological changes have exerted an influence on

the ICT management. On the socioeconomic level, we note that sustainable organizational models are the only ones to accept new modes of action and are capable of establishing and implementing the best practices of ICT strategic management. Many companies recognize the potential and the impact of "Green IT" which we will call "GIT" in the rest of our paper, on their organizations, on their global IT strategies, as well as on SD strategies [5, 6]. GIT refers to ICT with low impact on the environment and society through a continuous improvement approach of reduction of energy consumption, ecological, economic and societal footprint. The challenge we are facing is to integrate the ICT management strategy with the CSR and GIT concepts as illustrated in *Figure 1* in order to offer new opportunities for business and new sustainable management approaches.

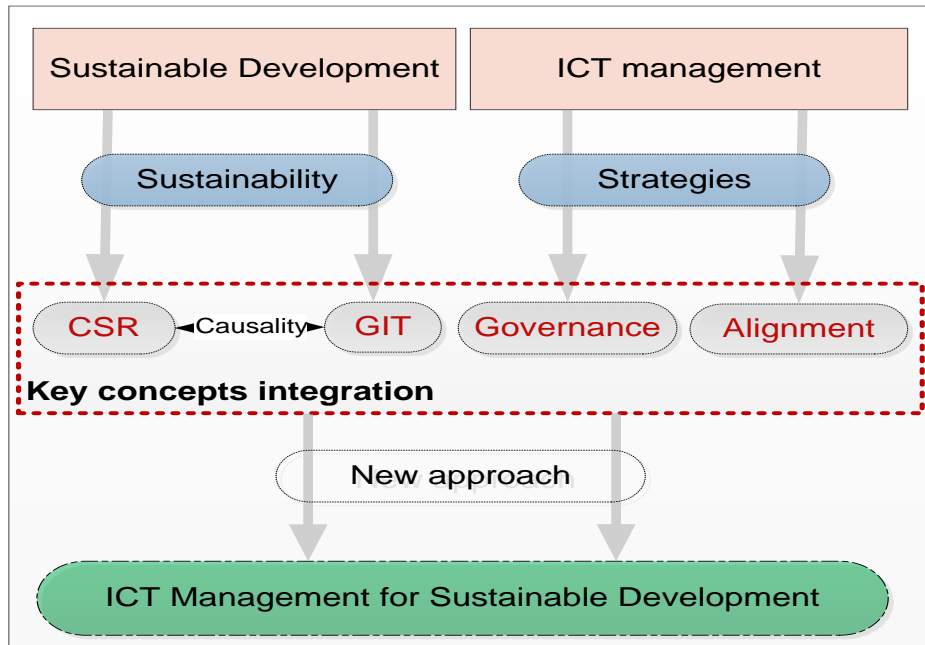


Figure 1 Proposed methodology for constructing the ICT sustainable management model

However, the growing number of approaches to implementing existing SD recommendations as well as the tools for realizing the GIT and CSR approaches makes more complex the development of new appropriate models for ICT management [7]. In the same way, the evolution of stakes and perspectives of ICT management pushes us to pilot a global reflection on the strategic approach and question the conventional management mode. Our goal is to integrate the GIT and the CSR and to evolve the existing approaches of ICT management

towards a great integration of sustainability relying on the "Triple Bottom Line" developed by John Elkington [8]. Our objective is to integrate sustainability concept offered by GIT and CSR into the ICT management strategy in order to align the overall ICT strategy with the overall SD strategy of the company. The challenge is to consider the economic, technological, ecological and societal objectives to guarantee certain equilibrium towards all stakeholders in a sustainable way [9].

In fact, the strategy of ICT management in the company focuses on the ICT governance and alignment models. The strategic alignment of ICT with business requires a global vision of these management models. Upstream, it is necessary to set up a reflection (strategic plan) on governance models, and downstream, it must give rise to an opportunity for steering and strategic alignment [10] that will help to drive the ICT management strategy. In order to carry out and manage this action, companies and organizations are constantly involved in the execution and completion of the management strategy of their ICT. To do this, it is first necessary to define the strategic management plan for these ICT [10] and in our context, we must take into account the potential of GIT and CSR. The implementation of the ICT management strategy is indeed dependent on the adoption of theoretical models of corporate governance and strategic management.

Profound evolution of ICT governance and alignment requires the use of strategic theoretical thinking to meet stakeholders' requirements and improve overall strategy in terms of competitive advantage. However, implementation of such a model raises theoretical and practical issues, which generate difficulties that are not yet fully resolved because of lack of research and insufficiency of good practice. To answer this problem, we adopt a two-pronged approach in order to meet companies' needs for adopting GIT and CSR practices in their ICT governance and alignment strategies on one hand, on the other hand, to lead and

participate in a reflection on SD-oriented ICT management models. This approach leads us to talk about a next generation managerial model, which aims to align CSR and GIT strategy with the overall ICT management strategy for a better alignment with the SD strategy of the company.

2.Literature review

2.1Systematic literature review

The SLR gathers the best evidence available in response to specific questions using robust techniques to research studies already performed, extracts scientific data, evaluates the quality of these studies, and synthesizes the results. The work we have done in this context aims to achieve the following objectives:

- Review proposals in an increasing number of publications on GIT and CSR.
- Seek the lack of literature in the field of GIT and CSR in relation with ICT management, and more specifically the ICT alignment and governance.
- Study decision-making approaches and help design new approach based on GIT and CSR for ICT management.

To succeed in our SLR, we adopted a methodology based on the PRISMA approach, which includes 27 control elements and four-phase flow diagram [11] (see *Figure 2*):

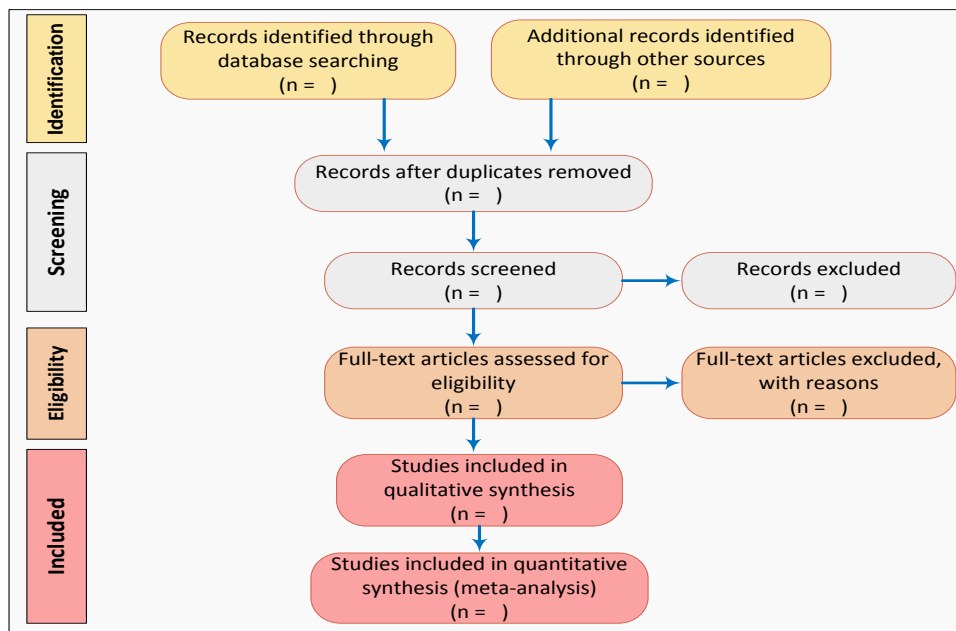


Figure 2 PRISMA approach flowchart

The first step in SLR is to write a research question, then select a database and start a bibliographic search with criteria evaluation. The second step is to evaluate the titles, abstracts and keywords of the selected scientific articles and finally evaluate the content of the articles according to the used criteria. The third step is to present the result of each study.

We used the "Publish or Perish" software (available on the Harzing.com website) for the selection of scientific articles published between 2016 and 2020. The databases we have targeted are Scopus, Google Scholar and Microsoft Academic. For our research, we used the following key words: ICT management, Green IT, Corporate Social Responsibility, IT Governance, IT Alignment, ICT Governance, ICT Alignment and Stakeholders' Theory. We identified a set of 18704 scientific articles on the three databases, and then we deleted 3731 duplicated items. Since the goal of our SLR is to search for articles that focus on integrating GIT and CSR concepts into ICT management processes, we have also excluded 2109 articles related to other fields such as tourism, education, health, sports, etc. Finally, we have selected 4571 articles that deal with the subject of ICT management.

We present in the next paragraph, the result of the SLR on the three chosen databases. In fact, we identified 4571 articles by applying the PRISMA approach. These references deal with the topic of integrating Green IT and corporate social responsibility in ICT management, as well as concepts of IT alignment and governance and stakeholders' theory.

2.2 Results of the systematic literature review

Among the 4571 articles dealing with ICT management, we have not identified any article that discusses the integration of GIT, CSR and stakeholders' theory into ICT management except the six articles that we published. Our six articles also discuss the ICT governance and alignment processes and focus on stakeholders' theory. We also identified 42 other articles that talk about Green IT only for ICT management, 120 articles that discuss the concept of corporate social responsibility and 18 articles for stakeholder theory. For ICT governance, we found, in addition to our four articles, 96 other articles dealing with this topic. The ICT alignment has been analyzed in 121 articles.

The analysis of the SLR results confirms the relevance of our research and shows a great lack in

the literature of works dealing with the integration of the new concepts of the Green IT and the corporate social responsibility in ICT governance and alignment processes. Among the 4571 articles identified in the three databases Scopus, Google Scholar, and Microsoft Academic, our six articles are indeed the only ones that speak about these concepts.

According to our systematic literature review (SLR), we assume that the integration of SD improves the ICT management process by the use of a systemic approach on the organizational, technological and strategic levels, providing a pragmatic roadmap, in order to take into account the concerns of stakeholders. In order to achieve this goal, we need to propose a next-generation model of ICT management to offer best practices and recommendations to success the integration of the sustainability concept into the overall management strategy.

3. Methods

The next chapter presents our new ICT management model for SD. The first point is to present the hypotheses of our work in relation with the issue of SD and ICT management. The second point describes our new model that we have called "ICT Sustainable Management". The third point presents the results of model evaluation through a case study of five companies with different categories.

3.1 Working hypothesis and problem

Since the emergence of the SD notion, the CSR and GIT concepts are increasingly taken into account in the ICT management strategy. New and rich thinking is opening up on SD-based management models by going beyond the commercial domain [12]. Thus, the integration of ecological concerns at the level of ICT innovation becomes essential in order to make a difference in a highly globalized and economically very competitive environment with greater impact on the environment and society. Therefore, it is important to develop a new ICT management method based on GIT and CSR to achieve sustainable ICT management, which will have an impact on the overall strategy of the company.

By using sustainable management practices respectful of SD issues, we will focus in our research on new ICT management systems that emphasize on strategies for implementing GIT and CSR in the ICT governance and alignment models for better integration of the SD in the overall management strategy of the company. The approach integrating the GIT and the CSR is considered as a guiding and

spine axis [13–15]. Our approach is to integrate GIT and CSR with two other dimensions of ICT governance and ICT alignment that allows us to clearly, understand the problem of integrating SD requirements into the ICT management modes within the organization. Our vision offers a global overview of the management mode based on sustainability. We must therefore focus on the ICT management processes, and at the same time on the overall strategy, taking care to deal with the impact on all stakeholders [3].

3.2A reminder of our proposed model

In our research, we have adopted a holistic vision of GIT and CSR in the process of ICT management in the company. This vision allowed us to deepen the analysis of using technologies with managerial best practices, through the proposal of a new model "ICT Sustainable Management". The implementation of this model is reflected in the design of a next-generation ICT management framework qualified as sustainable management, which will consider SD issues at the overall management strategy of the company. The Framework "ICT Sustainable

Management" described in the *Figure 3* consists of two dimensions "ICT Sustainable Governance" and "ICT Sustainable Alignment". These dimensions are built around a transverse axis that we have called "CSR and GIT Strategy".

For the transversal axis and each dimension, a set of axes has been developed. Then, for each axis, a set of strategies has been defined. Each strategy contains a set of practices and finally each practice contains a set of indicators that are produced for monitoring and measurement. Then, we defined the stakeholders and set up an application and control procedure with a user guide at each level of the model (dimension, axis, strategy, practice or indicator). 144 indicators were proposed, and for confidentiality reasons, details of the defined practices and indicators will not be given in this paper. Indeed, other research work is in progress for the implementation of a sustainable decision aid model, and also an IT tool based on these indicators has been developed and it is in the experimental phase within one of the selected companies for the case study in 3.4 paragraph.

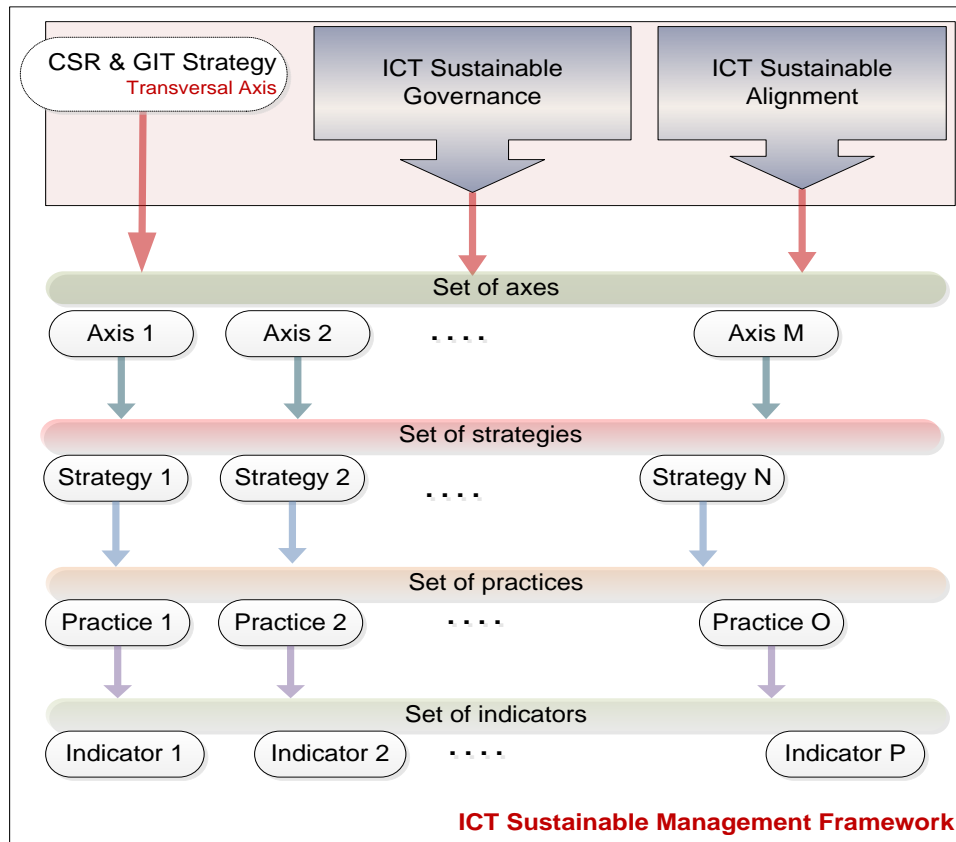


Figure 3 ICT sustainable management framework structure

In the following, we will first, detail the transverse component of the integrated CSR and GIT strategy. Then we will explain the two main dimensions "ICT Sustainable Governance" and "ICT Sustainable Alignment".

3.2.1 CSR and GIT strategy

The CSR and Green IT Strategy consists of three main axes of GIT and CSR: ICT life cycle, Use of ICT and Enterprise ICT. The key strategies that we selected for the development of these three components are described below in *Figure 4*:

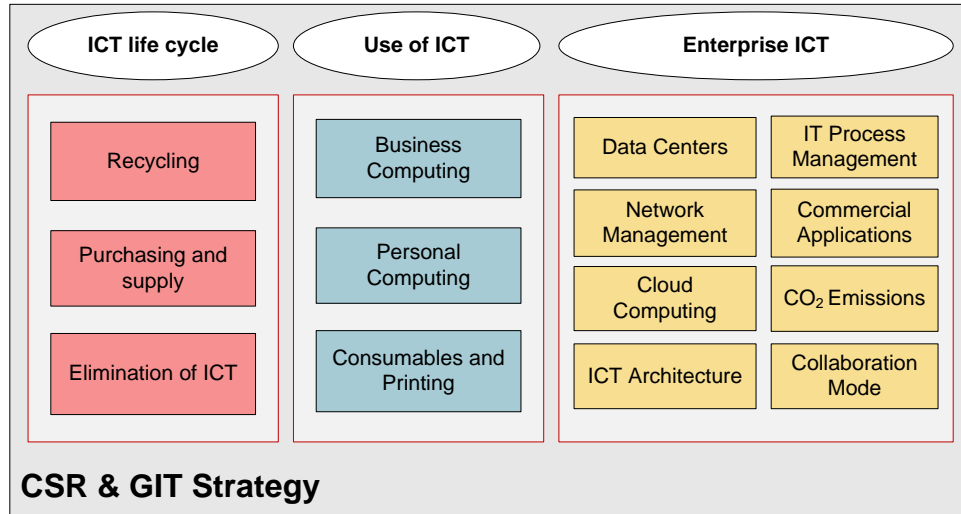


Figure 4 CSR and green IT strategy transverse axis strategies

a) ICT life cycle

This axis is interested in acquisition of IT equipment and services. It also concerns recycling and disposal of components at the end of the life cycle while respecting the environment with a low impact on society. ICT-related equipment is first manufactured, sold, used and then excluded. Disposing of equipment can be done by destroying it, as it can be done by transferring equipment to other parts of the organization.

b) Use of ICT

The use of ICT is the part of the end-user controlled ICT process. There are three areas affected: personal computing, business computing and the use of printing media with their consumables (toner, paper ...). The reduction of the carbon footprint and energy consumption in the company is first impacted by the way in which ICT is used and by the behavior and attitude of the employees. This then involves the use of good practices and techniques to achieve this objective.

c) Enterprise ICT

Enterprise ICT generally includes data centers, cloud computing, networking, software and application development... The choice for data centers in large

organizations is a more important means to achieve the objectives of the GIT and therefore allows better management of IT equipment and architectures, and therefore reduces the carbon footprint.

3.2.2 ICT sustainable governance

The first dimension of our framework consists of four main axes based on the GIT and CSR concepts: value creation, resource management, performance measurement and risk management. The strategies selected for the development of these four axes are described below in *Figure 5*:

a) Value creation

Value creation is ensured by the company's ICT management process through direct accountability of executive committees and IT managers. It consists of ensuring that ICT brings the expected economic, environmental and societal benefits as well as the technological component.

b) Risk management

Risk management is systematically part of the decision-making process because the company is always confronted with market fluctuations and its impact on its business. Risk management must indeed be very reactive in order to help maintain value creation and continuous improvement in a sustainable and more dynamic manner.

c) Performance measurement

Performance measurement is an essential part of the sustainable governance discipline to stimulate service delivery and validate the effectiveness of the management strategy. It consists by using balanced scorecards (BSC) of monitoring the implementation of the strategy, the culmination of projects, the efficient use of resources, the performance of business processes and applications, using balanced

scorecards that translate the strategy into actions oriented towards the success of measurable objectives. Measurement, monitoring and evaluation of the performance make it possible to meet the requirements of the company, through good decision-making and corrective actions.

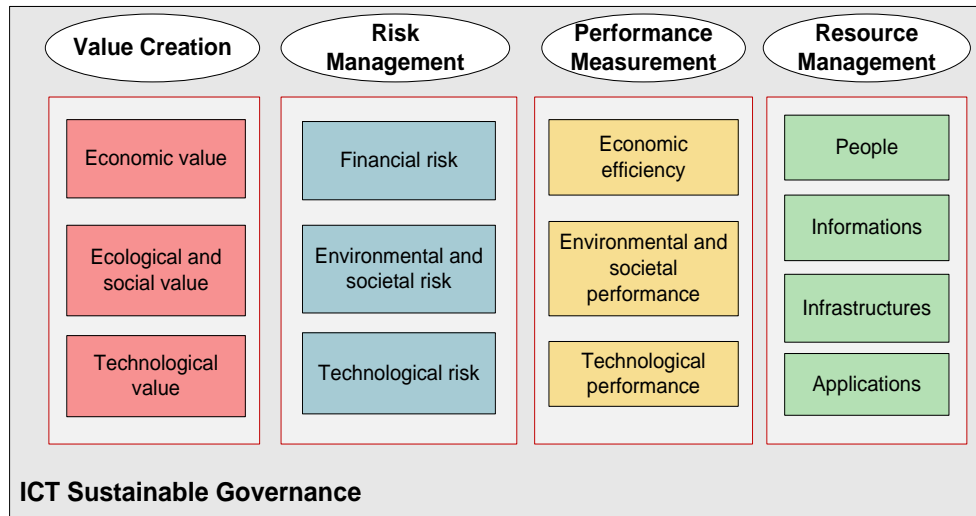


Figure 5 ICT sustainable governance dimension strategies

We propose an integrated approach to operationalize performance measurement in economic, environmental, societal and technological dimensions at the strategic decision-making levels. The objective is to apply the CSR triple bottom line principle in the ICT governance process and balance its performance across the three environmental, social, economic and technological dimensions. We identified three components of the balanced scorecard, each of equal importance, and each with associated objectives and metrics. The three components are:

- Economic efficiency
- Environmental and societal performance
- Technological performance

d) Resource management

Resource management is the most direct and controllable lever for achieving financial, societal and environmental objectives. It is the focus of our sustainable governance approach of maximizing and managing ICT resources and is grouped into four classes: People, Information, Infrastructure and Applications.

- People: the human resources necessary for the management, processing and maintenance of ICT

- Information: data, as inputs or outputs of the information system, whatever their form
- Infrastructures: technologies and facilities that allow applications to be executed
- Applications: automated systems and procedures for processing information

3.2.3 ICT sustainable alignment

The implementation of the "ICT Sustainable Alignment" dimension is based on the use of a new perspective of the Balanced Scorecard as illustrated in *Figure 6*. It takes into account the societal and environmental strategy in the ICT alignment strategy. The model we propose offers three following alignment perspectives:

- Alignment between business strategy and ICT strategy
- Alignment between ICT strategy and societal and environmental strategy
- Alignment between business strategy and societal and environmental strategy

a) ICT strategy

A rigorous approach has been taken to define the strategies of the ICT strategy in order to ensure a good alignment with the business, societal and

environmental strategy. The ICT strategy we propose focuses on the following three pillars; IT objectives, IT processes and infrastructures.

b) Business strategy

The business strategy that we propose is the second axis of the ICT Sustainable Alignment dimension and focuses on the following three pillars; business objectives, business processes and business skills.

c) Societal and environmental strategy

The societal and environmental strategy is based on three main strategies; environmental objectives, societal objectives and sustainability competence. This axis constitutes the third pillar of the ICT Sustainable Alignment dimension.

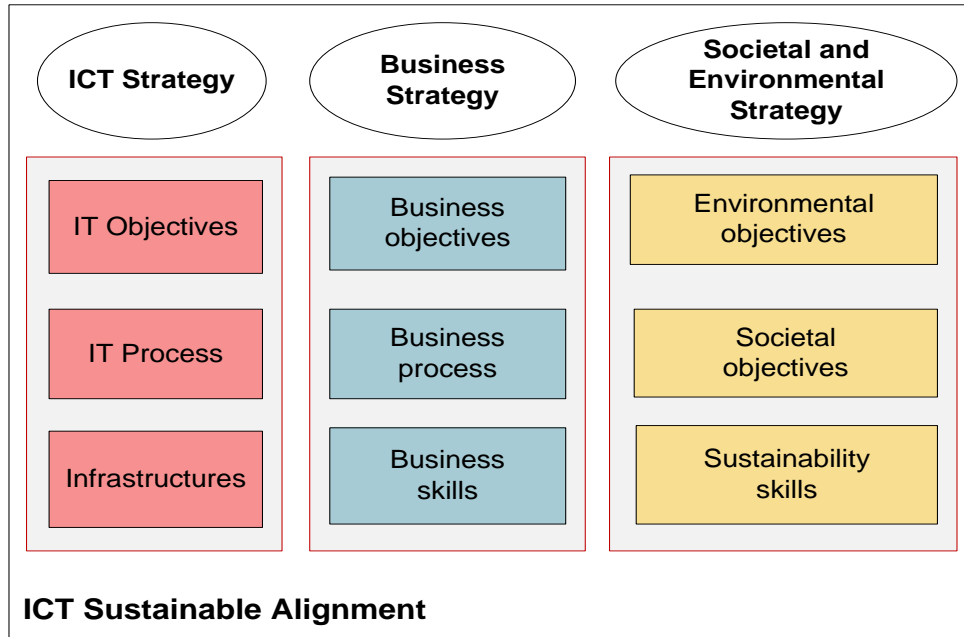


Figure 6 ICT sustainable alignment dimension strategies

3.3Automation of the model

In order to facilitate the application of our model, we have developed a software in J2EE technology for industrialization, automation of the model and integration of audit creation function, survey management, Sustainable Decision-Aid using Sustainability Balanced Scorecard (SBSC), Analytic Hierarchy Process (AHP), fuzzy DEMATEL technique and other future work. These new subjects

will be developed in another paper, which is currently being written. This allowed us, load data from surveys, documents and working meetings with companies and generate compliance and application reports for various indicators of the model. *Figure 7 and 8* provide an overview of the software and illustrate its use.

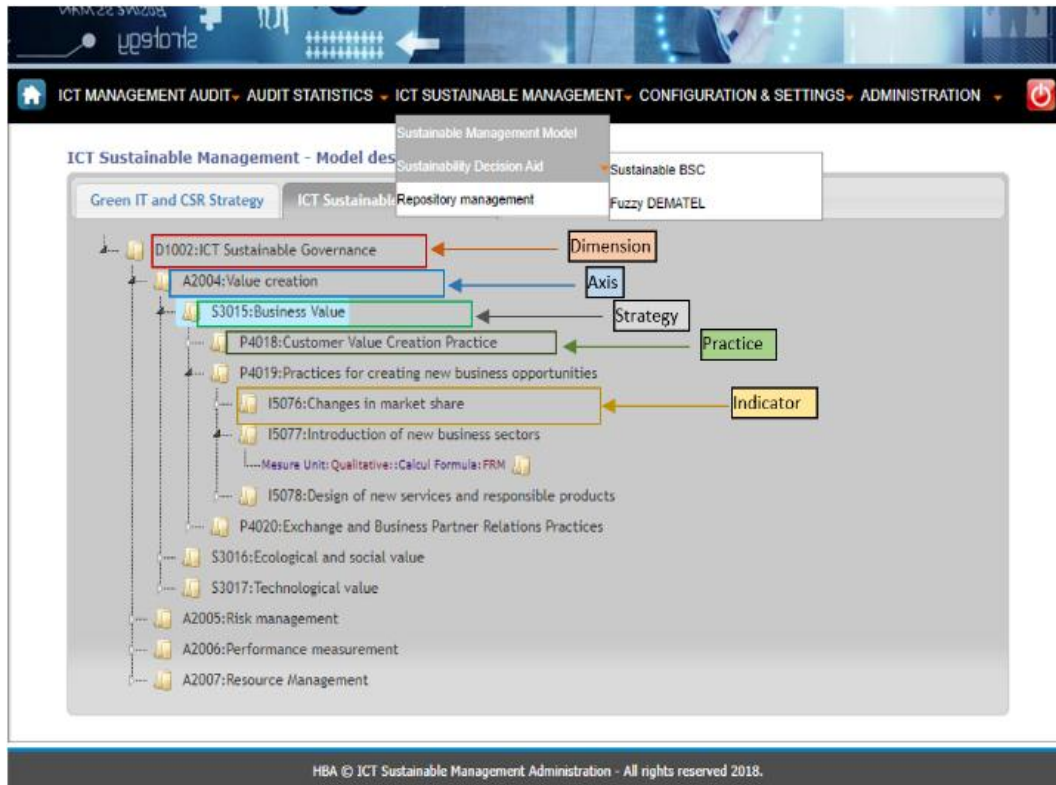


Figure 7 ICT sustainable management administration software

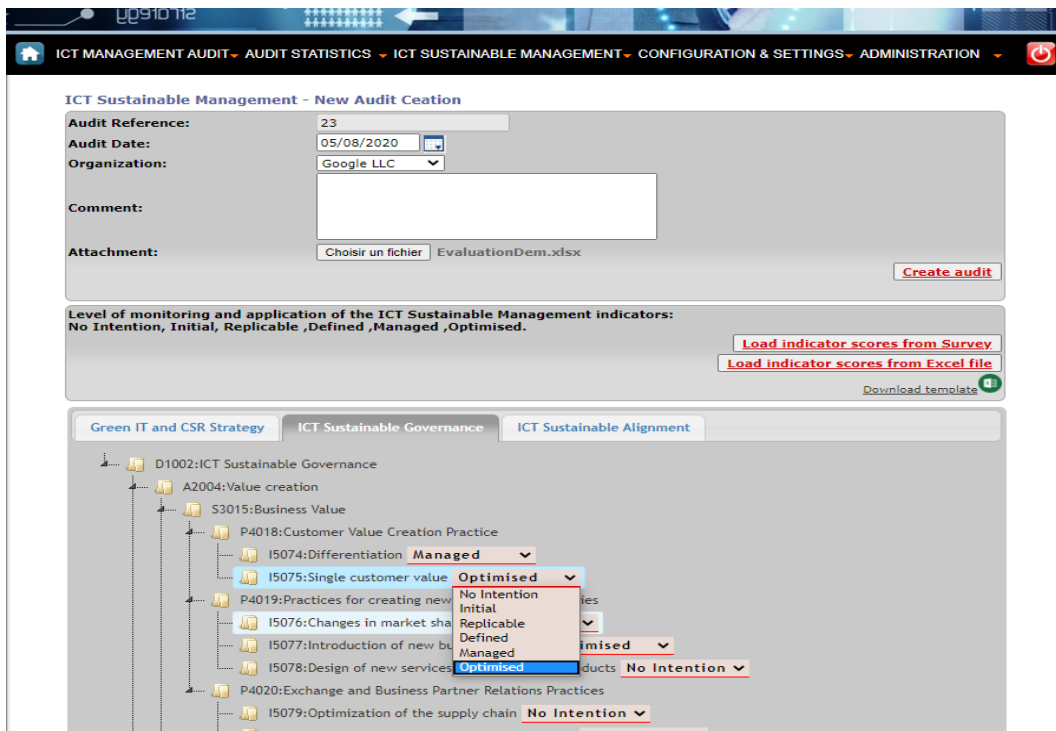


Figure 8 Screenshot of new case study creation

4.Results

The following section of the paper presents the results of the evaluation of our ICT Sustainable Management model in four Moroccan organizations: IAM, OCP, MASEN and Cosumar. We also checked our model for the case of Google Company in order to examine the different categories of companies. The objective of experimenting with our new model is to carry out an empirical study to generally compare the model's indicators with the managerial practices of the selected companies and analyze their ICT management methods.

We analyzed 159 reports and public documents relating to SD and ICT Management, which are published by the selected companies (SD annual reports, diagnostic results, dashboards, action plans, normative documents, procedures, etc.). These collected data were the subject of a qualitative analysis to verify the application of our approach that revolves around three levels. The first level makes it possible to analyze the data collected and verify the companies' adherence to the concepts of GIT and CSR in an integrated approach and this by validating all the indicators of each strategy implemented in our model. The second level consists in analyzing the companies' ICT governance process based on the indicators defined in the ICT Sustainable Governance dimension of our model. Finally, the third level concerns the validation of the ICT alignment process according to the ICT Sustainable Alignment dimension.

For the IAM company, In addition to public documents, we carried out the study of empirical data using questionnaires and several in-depth interviews with the heads of the IT Department and the SD Department, who had been key players in this case study. Analysis of the three levels shows the following findings:

- The CSR and GIT strategy is implemented in the company by the commitment to implement the principles of the global compact and the ISO 26000 standard (the group is certified “Top

Performer CSR 2019” by a European firm for the sixth time) by establishment of a set of 23 environmental and more than 58 societal indicators.

- The ICT governance strategy is achieved through the establishment of 12 strategies based on 46 best practices of ICT governance.
- The ICT alignment strategy managed according to the 5 alignment strategies put in place with 15 best practices.

We present below the results of our experimentation based on the studied documents related to SD and ICT management. The percentage values in the tables show the degree of compliance and application of our model indicators in each studied company.

A score ranging from 0 to 5 is assigned depending on the level of application and control of each indicator of our model in selected organizations:

- No Intention: no knowledge
- Initial: no implementation but some awareness exists
- Replicable: Strategy does not exist, with ad hoc implementation
- Defined: programs formalized with immature implementation
- Managed: programs implemented with adequate management
- Optimized: optimal management and performance

4.1.CSR and GIT strategy transverse axis

Following tables present, the application and control percentages of the indicators defined for each strategy for the three axes of CSR and GIT Strategy transverse axis.

Table 1 displays the percentages for the ICT life cycle axis. Table 2 displays the percentages for the Use of ICT axis. Table 3 displays the percentages for the Enterprise ICT axis.

Table 1 ICT life cycle axis evaluation

Strategy	Percentage (%) of indicator application				
	IAM	MASEN	Google	Cosumar	OCP
Recycling	98.75	85	90	80	80
Purchasing and Supply	66.67	97.78	95.95	88.89	82.22
Elimination of ICT	75	80	90	70	70
Total	80	87.6	92	79.63	77.4

Table 2 Use of ICT axis evaluation

Strategy	Percentage (%) of indicator application				
	IAM	MASEN	Google	Cosumar	OCP
Business Computing	96	95	90	90	95
Personal computing	99	100	100	100	100
Consumables and Printing	100	86.67	100	80	86.67
Total	98	93.9	97	90	93.83

Table 3 Enterprise ICT axis evaluation

Strategy	Percentage (%) of indicator application				
	IAM	MASEN	Google	Cosumar	OCP
Data Centers	100	95	100	90	85
Network Management	100	100	100	100	100
Cloud Computing	96.25	90	100	85	95
ICT architecture	90	100	100	90	90
IT process management	97.5	100	100	95	95
Commercial applications	100	100	100	97.78	97.78
CO2 Emissions	90	100	100	80	100
Collaboration Mode	100	100	98.57	91.43	91.43
Total	97	98.12	99.82	91.15	94.27

The verification of all the indicators of our model allowed us to assign a score to each strategy of the CSR and GIT Strategy transverse axis. The result confirms the inclusion of this axis in the overall management strategy in the selected companies.

4.2 ICT Sustainable governance dimension

Next tables show, the application and control percentages of the indicators defined for each

strategy for the three axes of ICT Sustainable Governance dimension. *Table 4* displays the percentages for the Value Creation axis. *Table 5* displays the percentages for the Risk Management axis. *Table 6* displays the percentages for the Performance Management axis. *Table 7* displays the percentages for the Resource Management axis:

Table 4 Value creation axis evaluation

Strategy	Percentage (%) of indicator application				
	IAM	MASEN	Google	Cosumar	OCP
Economic value	100	95	97.5	97.5	100
Ecological and social value	98.57	100	97.14	94.28	94.28
Technological value	70	96	100	56	64
Total	90	97	98.21	82.59	86

Table 5 Risk management axis evaluation

Strategy	Percentage (%) of indicator application				
	IAM	MASEN	Google	Cosumar	OCP
Financial risk	98.33	100	100	100	100
Environmental and societal risk	96.66	100	96.67	93.33	100
Technological risk	97.5	95	100	90	90
Total	97	98.33	99	94.44	96.67

Table 6 Performance management axis evaluation

Strategy	Percentage (%) of indicator application				
	IAM	MASEN	Google	Cosumar	OCP
Economic efficiency	100	100	100	100	100
Environmental and societal performance	100	100	100	96	96
Technological performance	82.5	100	100	90	100
Total	94	100	100	95.33	98.67

Table 7 Resource management axis evaluation

Strategy	Level of monitoring and application				
	IAM	MASEN	Google	Cosumar	OCP
People	100	100	100	96	94
Informations	100	100	100	100	100
Infrastructures	100	100	100	100	100
Applications	100	100	100	100	100
Total	100	100	100	99	98.5

Evaluation of the indicators of ICT Sustainable Governance dimension confirms, once again, the applicability of our model in these five companies. The results will be discussed in section 4.

4.3 ICT sustainable alignment dimension

Following tables show, the application and control percentages of the indicators that are defined for each strategy for the three axes of the ICT Sustainable Alignment dimension:

Table 8 displays the percentages for the ICT Strategy axis. *Table 9* displays the percentages for the Business Strategy axis. *Table 10* displays the percentages for the Societal and Environmental Strategy axis. The verification of indicators of the ICT Sustainable Alignment confirms the inclusion of all the strategies of this dimension in our case study.

Table 8 ICT strategy axis evaluation

Strategy	Percentage (%) of indicator application				
	IAM	MASEN	Google	Cosumar	OCP
IT Objectives	89	100	100	76	88
IT Process	100	100	100	100	100
Infrastructures	87.5	100	100	100	100
Total	92	100	100	92	96

Table 9 Business strategy axis evaluation

Strategy	Percentage (%) of indicator application				
	IAM	MASEN	Google	Cosumar	OCP
Business objectives	100	100	100	100	100
Business Process	100	100	100	100	100
Business skills	95.71	100	100	93.33	100
Total	99	100	100	97.78	100

Table 10 Societal and environmental strategy axis evaluation

Strategy	Percentage (%) of indicator application				
	IAM	MASEN	Google	Cosumar	OCP
Environmental objectives	75	100	100	100	80
Societal objectives	80	80	100	80	100
Sustainability skills	70	100	100	70	90
Total	75	93.33	100	83.33	90

4.4 Overall assessment of model application

Table 11 shows the overall percentages of indicators and strategies application of our model for the five companies. It displays the average percentage of

application for the transverse axis and the two dimensions of the model: The average percentage exceeds 90% for the five companies, which constitutes a very good score for this case study.

Table 11 Overall assessment of the model

Dimension	Percentage (%) of indicator application				
	IAM	MASEN	Google	Cosumar	OCP
CSR and GIT Strategy	91,67	93,21	96,27	86,93	88,37
ICT Sustainable Governance	95,25	98,83	99,3	92,84	94,96
ICT Sustainable Alignment	88,67	97,78	100	91,04	95,33
Total	91,86	96,61	98,52	90,27	92,89

5. Discussion

In this section, we will provide more details about the overall assessment of the experimentation of our model in selected companies. Then we will describe our analysis of the obtained results.

It emerges from our case study that the CSR and GIT Strategy is well taken into account by the five companies through the application of different strategies and practices of the three axes (ICT life cycle, Use of ICT, Enterprise ICT). The

implementation of this approach is based on the economic, social and environmental issues that are taken into account by the various organizational and technological functions.

In *Figure 9*, the percentage of overall application of all strategies and indicators of the CSR and GIT strategy transverse axis exceeds 86% for each company.

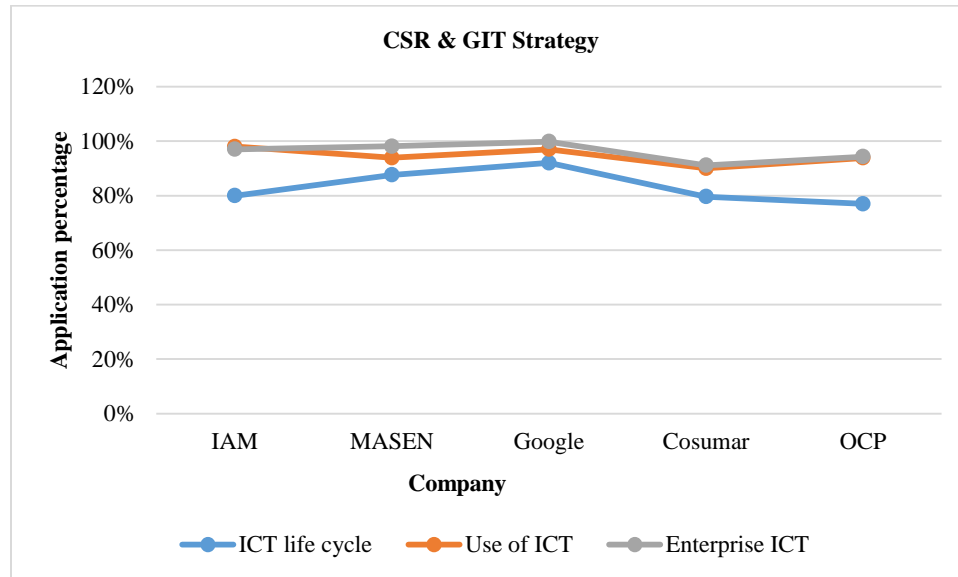


Figure 9 CSR & GIT Strategy transverse axis evaluation

In fact, taking into account internal and external visions of our model offered us a global perspective of ICT management. The internal vision consists in improving efficiency, minimizing costs of processes and improving the coordination of activities thanks to GIT and the CSR approach. The external vision makes it possible to use ICT in order to create unique customer value and achieve SD and stakeholders objectives. The following results will confirm our approach to applying these visions in the ICT governance and alignment process.

The evaluation of ICT Sustainable Governance dimension was very significant. We realized that the five organizations have a large program integrating the concept of GIT and CSR into the global governance strategy. We also note that the graphs for this dimension have the same aspect of the CSR and GIT Strategy dimension graphs.

In *Figure 10*, the percentage of overall application of the ICT Sustainable Governance exceeds 92% for each company.

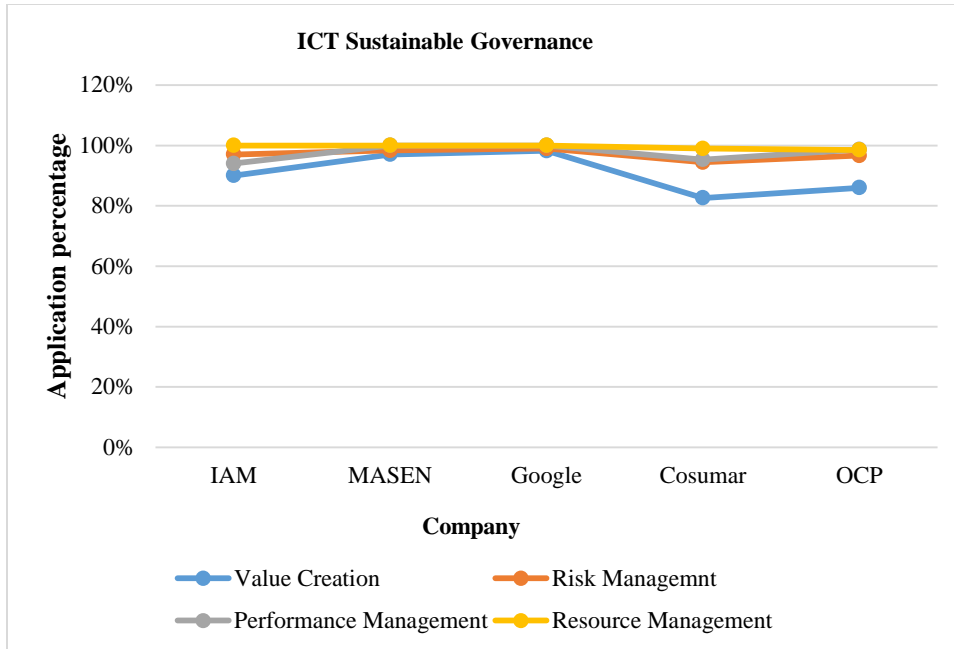


Figure 10 ICT Sustainable Governance dimension evaluation

The integration of GIT and CSR in ICT governance necessarily involved sustainable governance, which allowed identifying and structuring the demands of stakeholders and taking into account economic, environmental and societal concerns. Therefore, the mode and criteria of conventional governance are reinforced by CSR and GIT factors.

The calculation of the percentage of application for the ICT Sustainable Alignment dimension enabled us

to provide further proof of the validity of our model. We notice again that the graphs of this dimension have the same aspect of the graphs of the CSR and GIT Strategy and ICT Sustainable Governance.

From these results, we deduce that the percentage of application of our model for the ICT Sustainable Alignment exceeds 88% for each company (*Figure 11*).

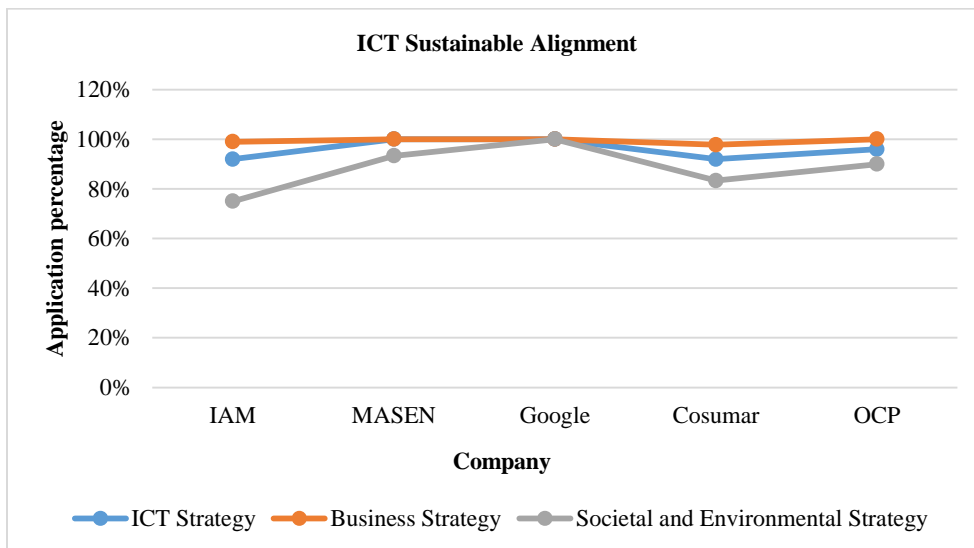


Figure11 ICT Sustainable Alignment dimension evaluation

Our approach is confirmed once again. From an internal point of view, a better synchronization of GIT and CSR actions with strategic directions and business lines of the company is made. This improved ICT alignment practices and boosted technological and organizational transformation and innovation. From an external point of view, our approach has improved competitiveness and developed leadership thanks to the differentiation effect created by transformation and organizational

changes. This impact on the ICT alignment is a very important element for intellectual property and branding of company.

Figure 12 shows the overall graph aspect for the ICT Sustainable Management model evaluation. The overall level of application of our model for this case study exceeds 90% for each company.

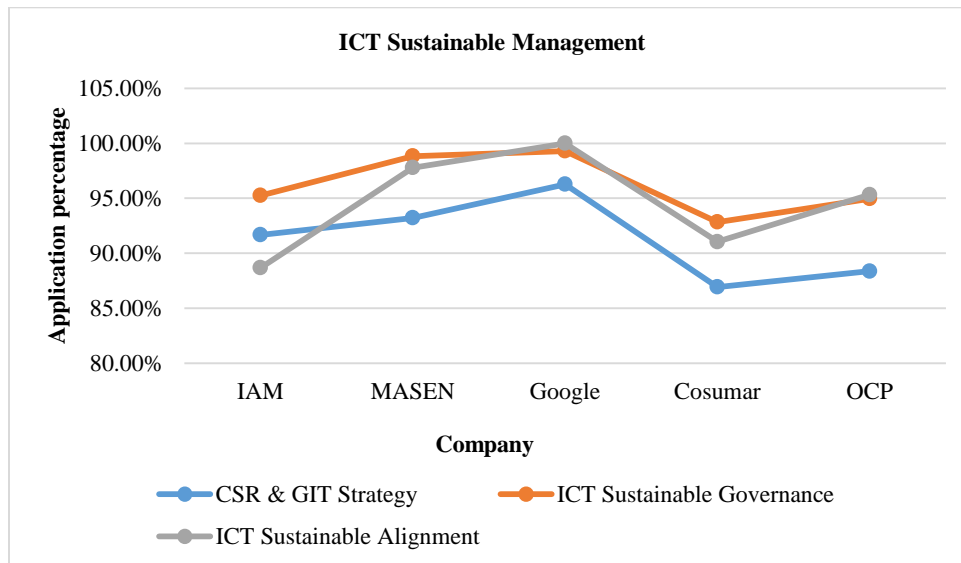


Figure 12 ICT Sustainable management graph

The obtained results confirm the existence of a correlation between the values of the transverse axis and the two dimensions of the model. Indeed, the adoption of a CSR and GIT strategy automatically implies the integration of these concepts at the level of governance and ICT alignment processes. They provide an answer to how the concept of sustainability should be integrated into the process of governance and ICT alignment. As mentioned in section 3.3, further work is underway to deepen our case study in other companies by introducing the Sustainability Balanced Scorecard, Analytic Hierarchy Process, fuzzy DEMATEL and Multicriteria Analysis. The goal is to provide a sustainable decision-aid model capable of predicting with sufficient precision future managerial trends according to the investment scenarios and the adopted strategies. Consequently, it will be possible for managers to identify the appropriate levers which can be measured, tested and readjusted and which will allow companies to improve their management methods.

The analysis of the results obtained from the study performed on the five companies which are of different categories and which have a SD program, allowed us to draw the following conclusions:

- The ICT Sustainable Management model is well applicable for the different categories of companies.
- A perfect alignment between the dimensions of the model, which proves that our approach allows the development of coherent and sustainable management strategies. The ICT Sustainable Management model offers a way to seek transition levers to develop new management methods based on sustainability.
- Our model can be used as control and audit tool for the management to verify the alignment with the overall SD strategy, also to support organizations in their strategic investment choices.

6. Conclusion and future work

The ICT Sustainable Management research model developed and tested in this paper provides a useful

tool for ICT researchers and practitioners to measure the degree of alignment and governance of ICT for the best integration of SD in the management of the companies. The model will serve as a base for researchers to design sustainable management models and contributes to the search for theories on next-generation ICT management systems. In fact, the proposed model is based on a holistic approach that has led us to focus on transversal and non-subordinate management methods that meet the requirements of all societal and environmental partners while guaranteeing economic benefits. Our innovative approach to ICT management is based on a simple principle that aims to implement the SD concepts. This approach combines the CSR and the GIT strategy to involve sustainability of the ICT management strategy in the face of the diversity of global management issues. This forced us to take into account the sustainability parameter, a key element of a better SD integration strategy for the transition to a new form of SD-based enterprise management.

The reports used for the study are public documents and may not reflect the reality of managerial practices and may even give or hide false information. This does not question our approach and the choice of five companies for the case study showed good results for the evaluation of the model. This experimentation encouraged us to explore other research perspectives. We consider it more appropriate to start from this model as a basis, in order to build, in future work, a framework of Sustainable Decision-Aid using Sustainability Balanced Scorecard (SBSC), Analytic Hierarchy Process (AHP) and fuzzy DEMATEL technique. As well as the development of a "Sustainable Management" Label allowing the certification of companies in the field of ICT management.

Acknowledgment

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Conflicts of interest

The authors have no conflicts of interest to declare.

References

[1] El Hilali W, El Manouar A. Towards a sustainable world through a SMART digital transformation. In proceedings of the international conference on networking, information systems & security 2019 (pp. 1-8).

[2] Porter ME, Kramer MR. Creating shared value. In managing sustainable business 2019 (pp. 323-46). Springer, Dordrecht.

[3] Hallstedt S, Ny H, Robèrt KH, Broman G. An approach to assessing sustainability integration in strategic decision systems for product development. *Journal of Cleaner Production*. 2010; 18(8):703-12.

[4] Reyes T, Millet D, Joan M. Development of ecodesign integration trajectories: two surveys and lca case of study with a power distribution products. In DS 42: proceedings of ICED 2007, the 16th international conference on engineering design, Paris, France, 28.-31.07. 2007 (pp. 141-2).

[5] Dutta S, Mia I. The global information technology report 2009–2010. In world economic forum and INSEAD, SRO-kundig Geneva, Switzerland 2010 (pp. 1-415).

[6] Dutta S, Mia I. The global information technology report 2010–2011. In world economic forum 2011 (pp. 331-91).

[7] Hernandez Pardo RJ, Brissaud D, Mathieux F, Zwolinski P. Contribution to the characterisation of eco-design projects. *International Journal of Sustainable Engineering*. 2011; 4(4):301-12.

[8] Elkington J. Partnerships from cannibals with forks: The triple bottom line of 21st-century business. *Environmental Quality Management*. 1998; 8(1):37-51.

[9] Hba R, Bakkas A, Manouar AE, Idrissi MA. Eco-strategy: towards a new generation managerial model based on Green IT and CSR. arXiv preprint arXiv:1605.03107. 2016.

[10] Henderson JC, Venkatraman N. Strategic alignment: a model for organizational transformation via information technology. Oxford University Press: New York; 1994.

[11] Moher D, Moher D, Liberati A, Tetzlaff J, Altman DG, Group P preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med.*;6:e1000097.

[12] Curley MG. Managing information technology for business value: practical strategies for IT and business managers (IT best practices series). Intel Press; 2004.

[13] Hba R, El Manouar A. ICT green alignment: towards a new generation managerial model based on green IT and corporate social responsibility. *International Journal of Advanced Computer Research*. 2018; 8(36):137-47.

[14] Hba R, El Manouar A. ECO-Strategy: New ICT management model built on the basis of the CSR strategy and Green IT. *International Journal of Computer Science & Information Technology*. 2017; 9(4):93-105.

[15] Hba R, Manouar A. Eco-strategy: CSR strategy and Green IT updated model for ICT management.



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