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Assessment of Green IT/IS Within the Aviation Industry Using the Analytic Network Process Approach

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Abstract *The purpose of this paper is to evaluate and assess the green information system and green information technology (IT/IS) investments within the aviation industry to help decision makers to reduce and overcome the negative impacts of Green IT/IS investment related to benefits, opportunities, cost, and risks. For this purpose, a total number of 380 usable questionnaires were collected from employees working in Egypt Air and 20 personal interviews were conducted with the experts. Data was analyzed using two techniques; SPSS version 16. So, Correlation analysis and Chi-Square tests (between benefits of green IT/IS and work experience) were conducted to find out the relationship between study variables (benefits, opportunities, cost and risks). The second technique was ANP version 2.8 software package for the interviews. Pair wise comparison, the unweighted super matrix, weighted super matrix, and limited matrix were used. Then the ANP priorities and the synthesized priorities for benefits were conducted. The results showed a positive correlation between opportunities, costs, and risks of green IT/IS. Despite green IT/IS benefits and opportunities, this does not negate the high cost of investments within the aviation industry, especially, the cost of powering IT infrastructure which had the greatest value from the experts' point of view. Green IT/IS is increasing concern because of either lower costs or increased costs.*

Keywords: *Green Information Technology, Green Information Systems, Aviation Industry, Assessment, Benefits*

INTRODUCTION

The integration of information technology and environmental issues has stimulated producers and designers to innovate, improve and develop green information technology (Green IT). Therefore, There is an urgent need at the global level for environmental sustainability (ES) and green information technology, as green information technology (IT) and the information system (IS) are important topics for research and related in IS discipline (Khor et al., 2015). The combination of environmental issues, green IT and their use in improving environmental sustainability encourage companies to adopt and develop issues related to green IT/IS initiatives (Dalvi Esfahani et al., 2015; Esfahani et al., 2015a, b).

In addition, green IT/IS researches have emphasized the sustainable development of information technology through a range of factors such as resource consumption, emissions, and energy efficiency (Boudreau et al., 2008). Although green information technology and the information system are distinguished, they alternately depend on the development of computer capacity, which in turn is consistent with the environmental, economic and social aspects defined by sustainable development. Green IT relies on hardware, software, server utilization, information center, power management, and proper disposal of expired devices (Jenkin et al., 2011). On the other hand, the Green Information System is an IT management that develops information systems to support environmental sustainability (Ryoo and Koo, 2013; and Watson et al., 2008). The green IS, for example, consists of management systems, environmental information systems and teleconferencing to enhance productivity and maximize profit for the company. Ijab et al. (2010) suggested that the adoption of the principles of environmental sustainability requires designers, manufacturers and service providers to provide and consolidate these principles during the various

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stages of use before, during, and after use of Green IT adoption. In addition, achieving sustainability requires the adoption and activation of a green organizational culture and business processes (Dao et al., 2011; Hart, 1995).

With the tremendous development of research in the field of information systems assessment for more than two decades (Jongsaguan, Ghoneim, 2016), the demand for evaluation and development of information systems remains urgent for organizations and companies. Especially those companies and organizations that deal with huge IT/IS technology and consequent spending on new infrastructure investments (Björnsson and Lundegård, 1992; Joshi and Pant, 2008; Jukic and Jukic, 2010; Bernroider et al., 2013).

As a result, when making a decision on the information system, the system must be evaluated and the benefits, costs, opportunities, and risks are taken into consideration (Irani et al., 2005 Irani and Love, 2008). In the same way, Bernroider et al. (2013) suggested that organizations should take into account tangible and intangible benefits and other factors associated with staff, and stakeholders. The Green IS Assessment and Sustainability are important environmental issues that are provided organizations and IT managers frameworks that support the measurement and assessment of organizational impact on sustainability (Pitotrowicz and Cuthbertson, 2009); Unfortunately, the costs and benefits of IT and green information systems are still the strongest elements (Daly and Butler, 2009; Dedrick, 2010). Thus, there is an urgent need to reduce the negative environmental impacts of air transport due to pollution and emissions from the aviation industry and their rapid deployment (Weir, 2013). In all probability, the aviation industry needs to adopt and implement green IT/IS practices and initiatives as the aviation industry relies primarily on information technology and its environmental impacts. (Jongsaguan and Ghoneim, 2016).

The purpose of this paper is to assess the Green IT/IS investments in the aviation industry to ensure the success of the implementation and management. In the following section, this paper will indicate the importance of costs benefits, opportunities, and risks which associated with Green IT/IS within the aviation industry, to ensure the success of the implementation and management. The Green IT/IS evaluation focused on benefits, costs, risks, and opportunities. So, the Analytic Network Process (ANP) is applied as it focuses on mutuality between elements, In addition to the application of SPSS. Furthermore, the research focuses on answering two questions: (1) what is Green IT/IS? (2) How can we evaluate and assess Green IT/IS investments within the aviation industry?

LITERATURE REVIEW

Green IT/IS

There is a clear distinction between IT and IS, but some studies use the two terms interchangeably (Melville, 2010). Therefore, they refer to IT as responsible for processing, storage, and networks. While IS is defined a set of elements that consist of people, processes, and technologies that assist in the processing of digital information (Dalvi-Esfahani, Ramayah, Nilashi, 2016). Boudreau et al. (2008) proposed another definition of the IS as a set of comprehensive software through information technology to achieve individual, collective or organizational goals. It is already clear that IT ‘‘encompasses the technological foundations of information systems” (Melville, 2010). Despite the distinctiveness of both IT and IS, their contribution to environmental issues is different (Chen et al., 2011). In short, IT can be represented as part of the problem and IS as part of solving the problem such as the problem of (energy consumption) and the part of its solution is (telepresence systems) (Boudreau et al., 2008; Watson et al., 2010).

IT/IS and its applications that aimed at pollution reduction, sustainable development, and product stewardship are called green IT and green IS (Boudreau et al., 2008; Chen et al., 2009). Green Information Technology and the Green Information System are among the most important technology strategies chosen by Chief information officer (CIOs) in 2008. Green IT relies heavily on energy-efficient information technology and low power consumption for information centers and servers. It is worth mentioning that what distinguishes the Green IS is that it provides the organization with many opportunities that help in addressing and solving complex problems related to the environment. Another advantage is that the system will be more sustainable as well as reduce the power required to manage IT (Boudreau et al., 2008). As green IT initiatives and green IS expand to achieve environmental sustainability, organizations and businesses can rapidly transform their operations for the benefit of the community economically and environmentally. (Esfahani et al., 2015b). It must take into account the technological, economic, legal or ethical aspects when starting to work in the green IT/IS strategy within the organization (Chen et al., 2011; Kuo and Dick, 2009).

Green Informatics constitute a new term in the science of information that describes the utilization of informatics in the interest of the natural environment and the natural resources regarding sustainability and sustainable development (Andreopoulou, 2009). Nowadays, ICT has introduced the convergence of e-services with broadband

network infrastructure, wireless technologies and mobile devices. (Andreopoulou, 2012). As Watson et al. (2008) stated Green IT relies on energy efficiency and equipment use, while Green IS focuses on planning and implementation of information systems to support and achieve sustainability through the sustainable business processes. Information systems assist and support decision-making processes by processing data and information, according to the individual, group and organizational levels within the firm or organization. Despite the fact that, Green IS is the best technological processor; Molla et al. (2009a) described it as a new field. While Chen et al. (2011) pointed out that this system does not result in rapid economic gains and therefore it is a weakness of the operation of this system. In general, the green IS is concerned with a range of activities that protect the environment implemented by companies that deal with IT as part of their participation in community responsibility (Schmidt et al., 2010). Since environmental issues are of great concern, and some of the responsibility is given to consumers, organizations should activate environmentally friendly (eco-friendly) standards in the use of electronic and electrical devices. No doubt that, green IT companies are the most environmentally friendly companies that use different sources of renewable energy, dispose of IT equipment in a responsible manner, implement at least a minimal amount of green technology (such as telecommuting) and apply the least of green information technology such as (virtualization and green computing) which limit energy consumption in information centers (Sinha, 2011).

Evaluate Green IT/IS within Aviation Industry

Actuality the aviation industry is one of the most developed and the fastest growing industry in the world among other transportation industries in the world (Sarkar, 2012). As for sea, land and rail, it is not as fast as air transport (Capoccitti et al., 2010). Despite the importance of the aviation sector for the transport and tourism sector, it affects negative impacts such as air pollution, noise, and climate change around the world and other negative economic and social impacts (Chang et al., 2015). In addition, there is an incontrovertible and imperious need to avoid or minimize the negative effects of air transport, as studies have shown that emissions and pollutants from aviation are increasing (Weir, 2013). According to Gartner Inc. (2007), the number of carbon emissions from industrialization and the use of ICTs are estimated at 2% of the global average, so it is comparable to the emissions from the aviation industry. Consequently, there is a need to adopt and implement green practices for information technology and information systems, it is well known that the aviation industry relies heavily on information technology, which has a negative and positive impact on the environment. One of the advantages of the Green Information System is to guide companies to reduce transportation costs by operating fleet management systems and aircraft control towers to avoid aviation accidents and reduce energy use. Besides, apply environmental guidelines on the quality of products, service achievements and the provision of information to customers, which enables customers to appreciate the value of green initiatives and make the decision to use them easily and effectively. This requires the company to deploy employees around the world to reduce the cost of travel and customer service efficiently (Dalvi-Esfahani et al., 2016). Thus, terms such as sustainable aviation and green aviation have emerged and are increasingly being used to solve the economic, social and technological issues facing the aviation industry and environmental challenges. Due to increased demand for air transport in developing countries and countries with emerging economies in Asia, Latin America and Africa, the growth of the aviation industry has increased between all modes of transport. For that reason, environmental sustainability and energy sustainability must address environmental challenges such as noise, pollution, fuel consumption and emissions for aircraft and airport operations (Sustainable Green Aviation, 2012).

Benefits

Firms can improve profitability through revenue growth by green IT through preferential access to certain markets (e.g., public sector, green products market) by adopting green strategies (Bonini et al. 2009). Prior studies argue that by increasing firm's corporate environmental consciousness, eco-initiatives and activities, firms enhance their corporate image and reputation (Hart 1995; Russo and Fouts 1997). IS here can support the firm by providing remote working beyond telecommunication through collaboration, group document management, knowledge management, and so forth (Dalvi-Esfahani et al., 2016). Green IT or Green Computing is a way towards more environmentally friendly and cost-effective use of power and production technology. Green IT is used as an umbrella term for overlapping concepts like virtualization, cloud computing outsourcing, recycling, procurement and power management, etc. The aspiration of Green IT is focused on achieving higher energy efficiency in the use of IT devices and to increase the utilization of already installed devices in data centers. At the same time, organizations need to deliver new IT Services in short time considering high reliability, performance and availability requirements as important issues in supporting the business processes (Uddin, Abdul Rahman 2012). Instead, Murugesan (2011) claimed that perhaps Green initiatives

appear to incur additional costs associated with Green software or tools needed to decrease energy consumption, achieve environmental ratings, create awareness among stakeholders, and re-engineer the business process to reduce the organization's carbon footprint. Exploring how organizations understand the benefits and costs associated with Green IT/IS practices is crucial (Jenkin et al., 2011).

Costs

Firms with higher green IT spending can save cost through green IT implementation measures. These cost-saving measures include lower energy and utility costs (Watson et al. 2010a), lower waste disposal costs, reduced usage of paper and other costly supplies, and many more tangible cost savings and resources (Hedwig et al., 2009). Firms might decide to use clients, which use less energy, in place of high -end computers. Organizations may use collaboration tools, telecommuting, telepresence and video conferencing tools to reduce costs due to travel. Furthermore, firms with higher amounts of green IT spending are likely to rationalize their production and operational processes to reduce environmental impacts. The rationalization involves re-engineering the production processes, eliminating unnecessary processes, or streamlining business processes to reduce the environmental impact and simultaneously lower the cost of the inputs and waste disposal (Cordano and Frieze 2000; Porter and Linde 1995). All these cost savings measures will reflect in the higher revenue (through reduced prices if cost benefits are passed on to consumers and price declines are more than offset by revenue growth) or direct impact on the bottom line of the firms (Mithas et al., 2010).

This leads to achieving higher revenues by winning in the environmentally conscious segments of the market. In addition, firms with higher green IT spending can differentiate their products from that of their competitors based on their environmental-friendly features (Bonifant et al. 1995; Shrivastava 1995). Firms can reach consumers with higher willingness to pay for such differentiated and higher quality product. Firms can increase their revenue through the production of "greener products" with less carbon footprint using green IT. Implementation of green IT can create a mindset and climate for the organization to move towards greener products across the value chain. Furthermore, firms with higher amounts of green IT spending can make use of their waste products and gain revenue from their usage or sale. Firm's research and development processes also undergo a chance to think through greener options and result in differentiated products (Ambec and Lanoie 2008). Further, once the firm achieves expertise in green IT; the expertise can be sold to other firms to gain revenue (Mithas et al., 2010).

Opportunities

While the opportunities and potentials of Green IT might be attractive, the extent of Green IT adoption, the motivating and inhibiting factors remain less researched (Molla, 2009). The air transport sector is characterized by a diverse workforce (Lynes and Andrachuk, 2008; Kivits et al., 2010; Smith and Grosbois, 2011; Kemp and Vinke, 2012) as it contributes to creating a good mental image of the organization and hence of the destination. At the same time as Smith and Grosbois (2011) confirmed that, some Airlines are increasing the number of their employees by recruiting women in management and employing disabled people (these initiatives are the most common and followed by the diversity of activities offered to encourage women to work) and thus increase and diversify the efficiency of employees. Thus, the organization can provide the skills, services, and possibilities to achieve competitive advantage through the diversity of the workforce. This is due to the airline's participation in green initiatives that help increase productivity and improve the skills of its employees (Lynes and Dredge, 2006).

In order to make green technology a standard for decision-makers, Bose and Luo (2011) decided that Green IT identifies a set of factors that reduce the company's carbon footprint: resource management, energy efficiency, and the application of green initiatives. Despite the lack of international or national standards to compare and evaluate green IT and IT for Green, but the interest in it has increased recently. Green IT is used to express computing while Information technology to green reflects the application of green practices to achieve environmental sustainability. There are many areas where airlines must be skilled, namely, energy and virtualization management, design of data centers, environment-friendly products, and alternative energy, taking into consideration recycling, product disposal and auditing processes (Murugesan, 2008). As environmental sustainability practices are expanding business goals for green information technology and green information systems were identified. Such as green energy, environmentally friendly transport, green industries, green ecosystems and waste management (Erek et al., 2009; Lee et al., 2013; Molla, 2009; Park et al., 2012).

Risks

Several factors pose a threat to green IT practices that could lead to their forbiddance as well as their perversion of environmental sustainability. Airlines must follow regulations, especially environmental protection laws, and inspect production permanently. However, these laws may lead to several abuse and omissions. Consequently, risks at any level of business and project management are a negative

result that is unacceptable and unpredictable. Risk can be measured and assessed by the probability of a negative outcome and the level of loss caused by the negative result. Chou (2014) identified the risks of implementing and applying Green IT/IS in:

- Shortage of the awareness of environmental sustainability.
- Green IT needs to expand knowledge.
- Management policy focuses on profit only.
- Lack of behavioral innovation for the individual.
- Insufficient awareness of social responsibility.
- Lack of awareness of the profession's ethics.
- Lack of government efforts.
- Insufficient of companies' experience in management and training.
- Inadequate data in compute Green IT value.

Seriously to avoid those risks, there must be a clear strategy for green IT goals in line with IT strategy and business strategy. So that this strategy is able to achieve the goals set in advance. Green IT needs to transform IT strategy into IT operations transparently and reliably to ensure effective coordination between business and IT (Uddin, Abdul Rahman 2012).

METHODOLOGY

The research focus of this study aimed at evaluating and assessing the green IT/IS investments within the aviation industry to ensure the success of the implementation and management. The Green IT/IS assessment focused on benefits, costs, risks, and opportunities.

Respondents

The target populations of this study are the staff of EgyptAir in Egypt. This company was chosen as they are supposed to be more knowledgeable and to have a basic understanding and relation to the topic of research in order to obtain significant data. The sample was randomly chosen. The survey was administered to 400 employees and 20 interviews. The mail survey, telephone call, and interviews were the main form of data collection. Data collection was carried out during the period from May to August 2017. There were 385 responses received, indicating an estimated response rate of 93 percent. However, only 380 of the questionnaires were valid.

Research Instrument

The data collecting methods of the study were questionnaire forms, semi-structured telephone interviews with experts, and interviews took place with managers and experts at different levels within EgyptAir to verify the gathered data. A pilot study was conducted to test the questionnaire validity. Reliability analysis on item-scale was conducted. In the questionnaire, Cronbach's alpha of the study measures was above 0.70. The questionnaire was prepared based on the Likert's 5 scale model. The questionnaire comprises of four sections. Section 1 is the respondents' profile. Section 2 consists of 8 inquiries to measure the benefits of green IT/IS investments within the aviation industry with a five-point scale ranging from extremely disagree (1) to extremely agree (5). The higher score of the five-point Likert scale means the higher benefits of green IT/IS investments within the aviation industry. Section 3 consists of 8 questions to measure the opportunity of green IT/IS investments within the aviation industry with a five-point scale ranging from extremely disagree (1) to extremely agree (5). The higher score of the five-point Likert scale means the higher level of green IT/IS opportunities. Section 4 consists of 10 questions to measure the costs of green IT/IS investments within the aviation industry with a five-point scale ranging from extremely disagree (1) to extremely agree (5). The higher score of the five point Likert scale means the higher level of green IT/IS's costs. Section 5 consists of 4 questions to measure the risks of green IT/IS investments within the aviation industry with a five-point scale ranging from extremely disagree (1) to extremely agree (5). The higher score of the five-point Likert scale means the higher level of green IT/IS's risks.

For analysis of interviews, The Analytic Network Process (ANP) was used. The Analytic Network Process (ANP) is a technique planned by (Saaty, 2001) who suggested a framework for decision-making or evaluation problems. It illustrates strengths and weaknesses in the case of scarcity of information. It creates clusters as a model of the problem using criteria (sustainability indicators) and alternatives for (tourism strategies). Then, links the elements on the network and creates feedback and interrelationships within and between clusters. This presents a fairly accurate model that illustrates the correlation between the elements available to assess sustainability. The strength of the ANP is shown in its use of nine scales (from 1-9) to determine all kinds of relations between direct and indirect criteria (Neaupane and Piantanakulchai 2006), (Saaty 2001). According to (Saaty, 2001), the ANP model comprises the following steps:

- Define network elements (clusters) and components (nodes) and define their relationships.
- Conducting pairwise comparisons on the clusters.
- Conducting unweighted matrix and weighted matrix between clusters.
- Transfer the weighted matrix to limiting matrix.
- find the essentials prioritizations according to the limit Matrix.

Measures Used in Study

Benefit: The measures of green IT/IS depend on the benefits costs, opportunities, and risks. Based on a five-point scale extremely disagree (1) to extremely agree (5). Example items include (according to experts interviews) "Our company is actively engaged in environmental sustainability initiatives ","Our firm has a strategic plan for environmental sustainability ","Your organization has a Green-IT policy ", and" Green IT / IS adoption to reduce overall emissions, waste and hazardous materials". Higher scores indicated greater levels of benefits.

Opportunity: In order to evaluate green IT/IS within aviation from subordinates, I used items (according to experts interviews) such as Green IT goals are included in the defined service levels, Your firm has a process for analyzing power consumption of IT equipment, Our firm policy to dispose of IT waste in the most environmentally friendly way, and adopting telecommuting as an energy-saving way for employees to work. Based on a five-point scale extremely disagree (1) to extremely agree (5). Higher scores indicated greater levels of opportunity.

Cost: Costs include items (according to experts interviews) such as "Your firm use cost-savings associated with Green tactics and strategies", "Your organization shifting towards virtualization to reduce the number of servers", "Reducing IT/IS's contribution to greenhouse gas emissions",and " Green IT/IS Reducing the cost of running data centers" Higher scores indicated greater levels of cost.

Risk: Risks contain items (according to experts interviews)**"**The high cost of Green IT solutions", "Unclear business value in greening IT/IS**",** Lack of business leadership on Green IT /IS, inadequate skills and training. Higher scores indicated greater levels of risk. The Cronbach alpha reliability for the benefits, opportunities, costs, and risks in this study was 0.750

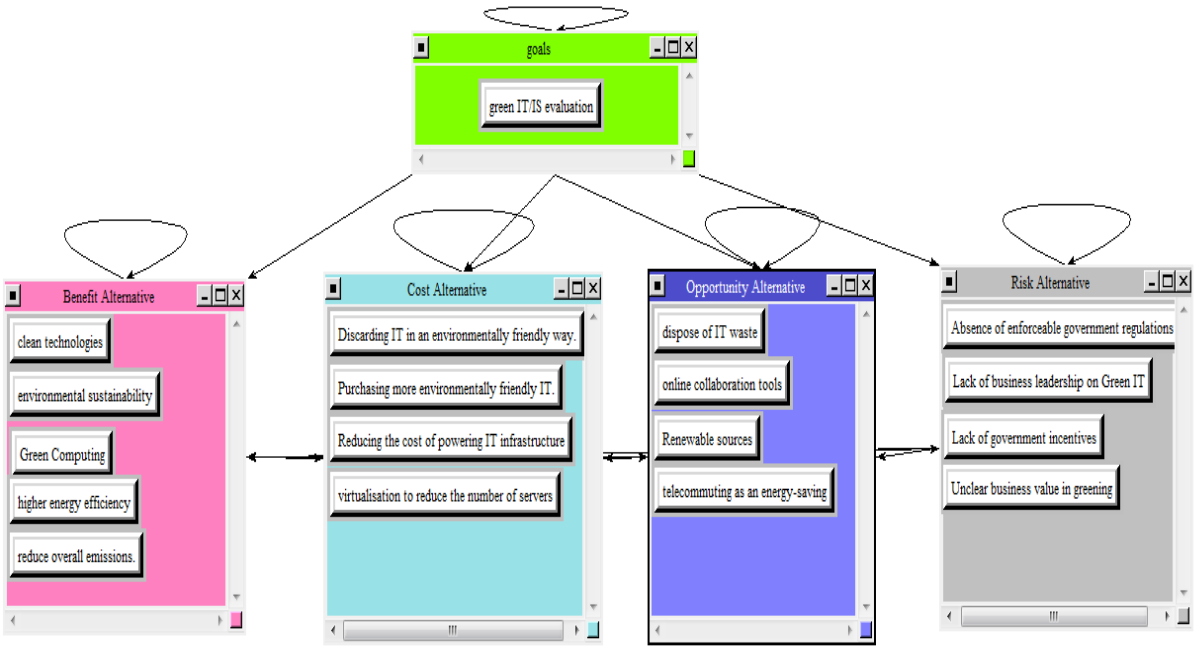

Fig. 1: ANP model of Green IT/IS Adoption

DATA ANALYSIS

Data were analyzed using two techniques. The first was SPSS version 16 software package. The suitable tools were used to test the hypotheses and find the reliability. Cronbach's alpha was used to test the reliability of the data, the mean and standard deviation have been calculated to classify the sets and determine how homogenous or discrepant (inconsistent) the sample is, regarding all research variables. A correlation analysis was then conducted to find out the relationship between benefits, opportunities, costs, and risks within the aviation industry. The second technique was ANP version 2.8 software package. Pairwise comparison, the unweighted super-matrix, weighted supermatrix, and limited matrix were used. Finally, the ANP priorities and the synthesized priorities for benefits were conducted.

RESULTS

Respondent Profile

Respondents' demographic data were analyzed by descriptive statistics using the SPSS 16. Table (1) shows the

demographic profile of respondents. Female respondents' represents (27.4%) slightly outnumbered their male counterparts 72.6%. Most respondents were relatively old. About (48.4%) of the respondents were more than the age of 50, with almost half of the sample (49.4%) falling into the age category of 31-50. In terms of work experience, (15.8%) of the respondents were from one year of experience to five years. Nearly half of the respondents (47.1%) falling into the range from six to ten years of experience. While (23.9%) of the respondents have experience ranged from 11 to 15 years, moreover the work experience of (13.2%) of the sample was more than fifteen years.

Table 1: The Profile of the Respondents

Variable	Sample (N=)	Percentage (%)
Gender		
Female	104	27.4
Male	267	72.6
Age		
24- 30	8	2.2
31- 40	78	20.5
41 - 50	110	28.9
more than 50	148	48.4
Work experience		
Less than 1 year	0	0
1-5 years	60	15.8
6-10 years	179	47.1
11-15 years	91	23.9
Over 15years	50	13.2

In the first examination of the data, a reliability analysis was performed for measuring the reliability of the benefits, opportunities, costs, and risks of green IT/IS investments within aviation in order to know to what extent these items have an internal consistency. Cronbach's alpha is used and employed here for that reason. The generally agreed upon lower limit for Cronbach's alpha is 0.71 (Nunnly, 1978; Ingram, 2009). The results of the reliability analysis are presented in Table (2). As the table shows, the reliability analysis gave alpha coefficients exceeding (.71), for the four constructs which are regarded as acceptable reliability coefficients and a good indication of construct reliability.

Table 2: The Measuring Constructs Reliability

N	Construct	Cronbach's Alpha
1	Benefits	0.750
2	Opportunities	
3	Costs	
4	Risks	

Then, descriptive statistics which incorporate the mean and standard deviation have been calculated to order the sets and find out how homogenous or discrepant the sample is, in regard to all research variables. The mean values for benefits of green IT/IS were ranged from 3.00 to 4.54 and the standard deviation from 0.046 to 1.057. Moreover, the mean values for opportunities were ranged from 2.578 to 4.773 and the standard deviation from 0.422 to 0.948. Costs were ranged from 3.234 to 3.447 and the standard deviation from 0.408 to 1.047. Finally, the mean values for risks of green IT/IS were ranged from 2.894 to 4.650 and the standard deviation from 0.498 to 1.452.

Table 3: Mean and Standard Deviation for the Study Variables

	Green IT/IS	Mean	SD
	Benefits	**3.897**	**0.870**
1	My firm has policies that encourage installation of software to reduce overall emissions.	4.542	0.599
2	Green IT / IS adoption to reduce overall emissions, waste and hazardous materials.	4.339	0.746
3	Executive leadership places high priority on environmental sustainability.	3.00	1.057
4	Staff places a high priority on environmental sustainability.	4.050	0.046
5	Our company is actively engaged in environmental sustainability initiatives.	3.815	0.767
6	Our firm has strategic plan for environmental sustainability.	4.276	0.730
7	The strategic plan for environmental sustainability specifically addresses the role of IT as a consumer of electrical power.	4.176	0.506
8	Your organization has a Green-IT policy.	3.781	0.848
	Opportunity	**3.915**	**0.827**
9	Green IT goals are included in the defined service levels.	4.773	0.535
10	My firm has policies that encourage installation of software to make material sourcing and acquisition more environmentally friendly.	3.931	0.708
11	The electrical power produced on site at your firm generated from Renewable / clean sources such as wind, solar, hydro, or biomass.	3.147	0.768

	Green IT/IS	Mean	SD
12	In the past 12 months, our firm's environmental sustainability initiatives have remained unaffected by pressures related to the economy.	2.578	0.948
13	Adopting telecommuting as an energy-saving way for employees to work.	3.842	0.838
14	My firm has policies that encourage online collaboration tools (beyond email) to substitute for travel.	4.734	0.422
15	Our firm policy to dispose of IT waste in the most environmentally friendly way.	3.952	0.695
16	Your firm has a process for analyzing power consumption of IT equipment.	3.439	0.598
	Cost	**4.134**	**0.666**
17	Your firm use cost-savings associated with Green tactics and strategies.	3.234	0.845
18	Your firm ensures that your suppliers meet Green criteria and their products support the business's Green objectives.	3.447	0.598
19	Your organization shifting towards virtualization to reduce the number of servers.	3.265	1.047
20	Reducing IT/IS's contribution to green house gas emissions.	4.39	0.591
21	Use of IT to supplant carbon emitting business practices.	4.163	0.467
22	Green IT/IS Improving the energy efficiency of data centres.	4.236	0.845
23	Green IT/IS Reducing the cost of running data centres.	4.331	0.744
24	Green IT/IS reducing the cost of powering IT infrastructure.	4.250	0.489
25	Purchasing more environmentally friendly IT.	3.210	0.408
26	My firm has policies that encourage installation of software to make the product distribution and delivery more environmentally friendly.	3.889	0.457
	Risks	**4.028**	**0.720**
27	The high cost of Green IT solutions.	3.336	1.375
28	Unclear business value in greening IT/IS.	2.894	1.452
29	Lack of business leadership on Green IT /IS, inadequate skills and training	4.455	0.498
30	Absence of enforceable government regulations and lack of government incentives for green IT/IS.	4.650	0.524

From table (4) the Chi-Square tests between benefits of green IT/IS and work experience indicated that the value of Chi-squared (29.25) is significant because the P value is (0.015). The conclusion is that this sample shows evidence at the 5%level that there is an association between benefits of green IT/IS and work experience about benefits of green IT/IS applied in their company.

Table 4: Chi-Square Tests Benefits * Work Experience Cross Tabulation

	value	df	Sig(2 sided)
Person Chi-Square	29.259	9	.015

Table 5 correlation indicated that there is a significant level of opportunities, costs, and risks of green IT/IS. The significant level was 0.000 when the error rate was 0.05 and when the confidence interval was 95%. This indicates the strong relationship between the variables. Furthermore, there is a correlative relationship between these variables. The link values were 0.644, 0.691, and 0,866 which is an extrusive strong link.

Table 5: Correlations Among the Study Variables

Variables	1	2	3	4
1. benefit	1			
2. Opportunity	-.016-	1		
3. cost	-.040-	.644**	1	
4. Risk	-.016-	.866**	.691**	1

** Correlation is significant at the 0.05 level.

According to table 6 the priorities of ANP indicated that benefits cluster gets priority between cost, opportunity, and risk. The node of (Reduce overall emissions) came in the first order with the greatest value of (0.31717) with respect to benefits. Furthermore, cost cluster came second after benefit, while the (Reducing the cost of powering IT infrastructure) node ranked first with respect to cost cluster. Opportunity ranked third while, (Renewable sources) node represented first place (0.40588) with respect to its cluster. The fourth cluster was risks which face green IT/IS within the aviation industry, and the first node was (Lack of government incentives). Furthermore, the limiting values of benefits and opportunities exceeded the limiting values of costs and risks.

Table 6: ANP Priorities Obtained from ANP

Clusters	Name	Normalized By Cluster	Limiting
Benefits	Clean technologies	0.27581	0.084138
	Environmental sustainability	0.17354	0.052939
	Green computing	0.13113	0.040003
	higher energy efficiency	0.10234	0.031218
	Reduce overall emissions	0.31717	0.096755
Costs	Discarding IT in an environmentally friendly way	0.32991	0.014385
	Purchasing more environmentally friendly IT	0.08589	0.003745
	Reducing the cost of powering IT infrastructure	0.43398	0.018923
	virtualization to reduce the number of servers	0.15022	0.006550
Goal	green IT/IS evaluation	1.00000	0.505075
Opportunities	dispose of IT waste	0.27955	0.032425
	online collaboration tools	0.11373	0.013192
	Renewable sources	0.40588	0.047078
	telecommuting as an energy-saving	0.20084	0.023295
Risks	Absence of enforceable government regulations	0.20830	0.006307
	Lack of business leadership on Green IT	0.08818	0.002670
	Lack of government incentives	0.56128	0.016995
	Unclear business value in greening	0.14224	0.004307

Table 7 showed that benefits of green IT/IS could arrange according to their values in descending order to highlight their importance as follows: Reduce overall emissions (0.317174), clean technologies (0.275814), environmental sustainability (0.173540), Green Computing (0.131135), and higher energy efficiency (0.102336).

Table 7: The Overall Synthesized Priorities for Benefits Obtained from ANP

Name	Ideals	Normals	Raw
Clean technologies	0.869598	0.275814	0.084138
Environmental sustainability	0.547144	0.173540	0.052939
Green Computing	0.413448	0.131135	0.040003
Higher energy efficiency	0.322650	0.102336	0.031218
Reduce overall emissions.	1.000000	0.317174	0.096755

DISCUSSION AND CONCLUSION

This study employed to discuss, evaluate and assess the importance of the green IT/IS investments within the aviation industry. The Green IT/IS evaluation focused on benefits, costs, risks and opportunities to ensure the success of the implementation and management. This is consistent with Huijts et al., (2012) where they confirmed that IT based on environmental sustainability includes: 1) Assessment and measurement of benefits, cost and risks, 2) Measuring the ethical impact of technology positively or negatively on society and the environment, and 3) finally their impact on individual feelings such as fear, joy, satisfaction and dissatisfaction. The demographic profile of respondents indicated that survey participants were relatively over 50 years, and there wasn't a balanced gender distribution between male and female respondents. Furthermore, the results of this study suggested that male employees were more than female. The results of the work experience refer to nearly half of the respondents have experience ranged from 11 to over 15 years.

Furthermore, Chi-Square test was used and indicated that there is an association between benefits of green IT/IS and gender with men agreed about benefits of green IT/IS applied in their company. The value of green IT /IS should be clarified and highlighted for employees whether their views are negative or positive for green practices (Jenkin et al., 2011). Correspondingly, Dedrick (2010) suggested that support and empower employees to study and understand green IT/IS initiatives, help the organization to adopt and apply the idea. Airlines are engaging their employees in training on green environmental practices and initiatives Such as feedback and reward system for environmental participation programs, besides, providing time models for work to implement environmental practices and initiatives (Lynes and Dredge, 2006). For instance, they are increasing the number of employees involved in green IT/IS to overcome CSR/green environmental issues or barriers (Smith and Grosbois, 2011) Like employee opposition and non-cooperation with new green initiatives (Jenkin et al., 2011).

From the statistic analysis of questionnaires collected from 380 full-time employees in Egypt Air, the evaluation of Green IT/IS by IS traditional techniques, highlighting the benefits, costs, opportunities, and risks associated with such investment. There is a lack of application of green IT/IS models, which are considered a tool for evaluation and development by those responsible for managing the organization. All of the four factors have a positive impact and correlated except benefits. While; ANP priorities give benefits the first rank because of its importance. This is maybe because of the differences between the viewpoint of employees and experts (who are more experienced). According to Ko, et al. (2011), green technological innovation strategies are viable as they generated significantly higher profit ratio and lower cost ratio to Green IT innovators than Green IT followers. Consequently, results indicated that benefits and opportunities gained great value compared to costs and risks. But that does not negate the high cost of green IT/IS investments within the aviation industry, especially, the cost of powering IT infrastructure which had the greatest value from the experts' point of view. Green IT/IS is increasing concern because of either lower costs or increased costs. Green IT/IS is not necessarily cost-effective and really expensive (Watson, et. al., 2010a; Watson, et. al., 2010b). Risk should be considered to manage and reduce, especially, (lack government incentives) and, (absence of enforceable government regulations).

Therefore, airlines should adopt the application of green information technology in their work and train employees on ways to use it as a solution to preserve the environment and achieve sustainability. The Civil Aviation Organization should provide a clear strategy to implement green IT/IS and determine how to evaluate and measure the yield. As well as the role of government to provide incentives and flexible government regulations to adopt and implement green IT/IS policies.

FURTHER RESEARCH

This study concentrates only on the assessment of green IT/IS within the aviation industry, it leaves a scope for future researchers to examine the effects of green IT/IS on employees' performance. In addition to this, future researchers should measure the ethical impact of green technology positively or negatively on society and the environment, and their impact on individual feelings such as fear, joy, satisfaction, and dissatisfaction**.** Accordingly, further research would be necessary to understand how to increase environmental awareness of individuals, to increase the sense of responsibility towards the environment, to change attitude towards the Green IT/IS, and to encourage ethical commitment to practice Green IT/IS initiatives.

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