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Impact of adoption of Green IT practices on organizational performance

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Abstract Sustainable development is a widely debated issue around the world and there has been increasing pressure on firms to adopt practices that are more environment-friendly. Among the most crucial practices are Green Information Technology (IT) practices, as most firms use some form of IT to perform their daily transactions. This paper examines the factors that affect the adoption intensity of Green IT practices and their subsequent influence on the firm's performance in the context of a developing country, Iran. The data were collected using survey questionnaires administered online to 277 managers who handled IT adoption in companies listed on the Tehran Stock Exchange. Results obtained using structural equation modeling (SEM) reveal a positive relationship of Green IT practices with institutional pressure, Consideration for Future Consequences (CFC) and openness. We also found a positive relationship between Green IT practices and organizational performance. A discussion of these findings, future research directions and limitation of this study are presented.

Keywords Green IT practices · Sustainability · Environmental performance · Economic performance · Iran

1 Introduction

Environmental and climate topics are no longer a major concern for environmental scientists and international and national regulators only, but have also become the core focus of the business world (Melville 2010; Watson et al. 2010). Businesses are under growing

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pressure from competitors, customers, regulators and community groups to implement sustainable business practices. Implementing sustainable business practices such as the adoption of Green IT practices provides a win–win situation for the internal as well as external stakeholders of a firm. It has thus become important for firms these days to incorporate sustainability philosophy into their strategy and the competitive concepts around the world have been revised because environmental management has affected all facets of a company's strategy (Chen 2013; Chen et al. 2014).

Green IT practices refers to those practices that deal with issues of material and energy resource consumption, environmental pollution, disposal and recycling, and related processes. Firms use information and communication technologies (ICTs) directly or indirectly to realize the economic, environmental and social benefits of greening (Watson et al. 2010). Research has shown that firms benefit from adoption of sustainable business practices in many ways—in terms of financial value and economic performance due to enhanced revenues and lower costs, for example (Christmann 2000). At the same time such adoption of Green IT practices helps firms ward off normative pressures coming from different stakeholders including regulators, customers, competitors, community and other groups and associations (Epstein 2008). Thus, balancing economic and environmental performance to be competitive and green has become a key strategic issue for firms (Molla et al. 2009). In view of this, leading firms around the world have increasingly recognized the importance of managing environmental performance. The awareness of this concern has further been bolstered by the international economic crisis which in turn has been a blessing for the sustainability movement.

Despite such awareness of the issue of sustainability in literature, the information systems (IS) researchers seem to have been slow in contributing to this discussion. The role of information technology (IT) in resolving ecological sustainability, in building green reputation capital and in supporting corporate green strategies has hardly been researched (Molla and Abareshi 2012). The potential roles of IT for greening businesses are enormous, but not explicitly understood by businesses. Therefore, there is a need for IS scholars to discuss how IT enhance sustainable development of businesses (Trimi and Park 2012). In this regard, two questions in particular merit answers. The first question relates to the factors that influence the adoption of Green IT practices by an organization. The second one concerns the impact of Green IT practices on organizational performance.

In relation to the first question, past research has dwelled on different drivers of environmental strategy adoption—from the firm as well as individual perspectives. At the firm level, for instance, Russo and Fouts (1997) posited that environmental performance is positively linked to economic performance while Atlas and Florida (1997) showed that the adoption of green (product) design is primarily determined by organizational opportunities and resources. Other studies have focused on individual or managerial level drivers of environmental strategy adoption. For instance, Egri and Herman (2000) studied leaders' personal values while Sharma and Nguan (1999) analyzed managerial issue interpretations and risk propensities. While these studies have helped in putting together pieces of the puzzle, not many studies focus on both the institutional level and individual level determinants of Green IT practices (Gholami et al. 2013). Motivated thus, in this paper we take forward both these streams of research and present a model that studies together the institutional and individual determinants of Green IT practices adoption. Combining both perspectives in one study provides a wider overview of adoption of Green IT practices in organizations. The institutional perspective provides a useful lens to study the organizational response to environmental issues (Chen et al. 2009) whereas the individual

perspective allows us to identify how individuals such as managers react to adoption of Green IT practices (Mithas et al. 2010).

In relation to the second question, we study the effect of adoption of Green IT practices on organizational performance. As noted above, firms are known to achieve higher organizational performance due to adoption of sustainable business practices. It becomes interesting to explore if this finding holds in a developing country, Iran. Although there are some empirical studies that have been carried out on Green IT practices adoption and practices in developing countries (Molla and Abareshi 2012; Vykoukal 2010), this paper is different as it focuses on Iran, a country that has not received much attention viz-a-viz the issue under consideration.

Iran is one of the main non-renewable energy producers in the world due to its abundance fossil fuel resources. Due to low prices the utilization of natural gas and petroleum in transportation and industrial sectors has been developed vastly in Iran. Since there are plenty of fossil fuel resources in Iran, the country has not considered any alternative fuel and renewable resources which is not in accordance to the country's sustainable development plans. Thus, the Iranian Government have put in place several procedures to control the consumption of unbridled fossil fuel (Hosseini et al. 2013).

Hanne (2011) believed that people may think that Green-IT practices cannot be a priority in developing countries. However, the author believes that this new field will be of a great interest once developing countries confront the problem of e-waste and realize that Green-IT offers opportunities and allows for economic, social and environmental benefits (Hanne 2011).

The motivation for sustainability in developing economies can be viewed from at least three perspectives. First, firms in developing economies are realizing that they can approach sustainability from a return on investment perspective. The incremental investments in greener technology can be financially recouped, besides other positive externalities such as better image among customers, employees and other stakeholders. Second, reducing energy consumption and requirement for back-up power generation (developing economies often have electric power shortages necessitating use of back-up power generation facilities) can also lower capital expenditure costs significantly. For example, firms can substitute laptops for desktops to reduce energy consumption and to avoid use of uninterrupted power supply systems. Third, in some sectors such as telecom and banking, energy consumption costs are a significant fraction of the total revenues, and any initiatives to reduce energy consumption in these sectors can have significant bottom-line impact (Mithas et al. 2010).

This paper contributes to theory and practice. It fills a gap in the current literature by explaining the role of three factors that impact the adoption intensity of Green IT practices. Although institutional pressure has been studied in the context of adoption of Green IT practices (Chen et al. 2009), it has not been studied together with CFC and openness. Theoretically, the paper addresses the call for a body of empirical research that studies the factors influencing the adoption of Green IT practices (Dedrick 2010; Melville 2010; Molla and Abareshi 2012, Malhotra et al. 2013). Following this section, this paper proceeds with a discussion of the background to Green IT, Green IT Practices and Adoption intensity of Green IT Practices, presents the research model and hypotheses, describes the research methodology, and reports the findings, provides a discussion of the findings and finally presents the conclusions of this study.

2 Background to related concepts

2.1 Green IT

Green IT refers to the design and implementation of information systems that contribute to sustainable business processes (Chen et al. 2011). Over the last few decades, the advance of business and social practices based on information technology has transformed many economies into e-economies and many businesses into e-businesses. For economies, IT increasingly plays a critical role in transforming and generating economic opportunities (Molla et al. 2009). On the other hand, global warming and climate change, combined with restricted availability and increasing cost of energy, are posing serious challenges for the sustainability of the global digital economy. IT has a potential to create sustainable business and society in both grim and green economic times. In particular, the recovery from the existing economic crisis is going to need and lead to greener and more energy efficient industries. It is in this wider context of the technology-sustainability nexus that "Green IT" has emerged as one of the top issues of concern for IT and business managers (Molla et al. 2009). Murugesan (2008) mentioned that organizations that adopt Green IT practices would benefit. For example, through green initiatives, IT operations may achieve better energy efficiency, which subsequently benefit them financially particularly when the cost of energy is high.

2.2 Green IT practices

A number of technologies and practices constitute Green IT. These technologies facilitate what is known as Green IT practices, and include collaborative technologies, such as video and teleconferencing, enterprise carbon and emission management systems and energy informatics systems. The practices consist of implementing policies for using IT to manage emission, energy and other assets of the enterprise. For that reason, the use of IT to enhance energy efficiency and the transformative power of IT in managing energy efficiency has been proposed (Watson et al. 2010). Information systems can form attitudes of individuals and organizations in relation to improving economic and environmental performance (Melville 2010). In addition, IT can improve carbon productivity as input to production systems by optimizing production processes (Dedrick 2010). Moreover, Watson et al. (2010) demonstrate the transformative power of IT to create an environmentally sustainable society. For example, RFID systems can be utilized by organizations to tag and track each unit of pollution and assign and measure the external environmental costs to the society in terms of low quality air and water. In this form of transformative power of IT, society can use this information to "internalise these externalities" (Watson et al. 2010).

2.3 Adoption intensity of green IT practices

The intensity of the adoption of Green IT practices is the extent to which an organization is embedding IT in its pollution prevention, product stewardship and sustainable development strategies (Chen et al. 2011; Hart 1997). Pollution prevention focuses on the prevention and control of polluting emissions during and after production and operations processes (Hart 1997). Product stewardship requires environmental impacts to be considered throughout the whole lifecycle of the organization, comprising raw-material sourcing, product design and development processes (Hart 1997). Hart (1997) argues that

companies can clean up their unsustainable practices through sustainable development principles that conserve materials, are non-polluting, are energy efficient and generate low waste.

3 Research model and hypotheses

This section discusses the factors influencing adoption of Green IT practices and also the impact of adoption of Green IT practices on organizational performance.

3.1 Institutional pressure

The institutional perspective provides a useful theoretical lens through which to investigate the organizational response to environmental issues because it assumes that institutional forces beyond the market play a vital role in making firms responsive to the interests of others. Institutional theory has been employed to explore firms' environmental behaviors (Campbell 2007; Chen et al. 2011). Chen et al. (2011) examine how organizational adoption of Green IT practices is motivated by institutional forces. More recently, Butler (2011) found that regulative, normative and cultural-cognitive forces from the institutional environment shape the organizational field of the IT manufacturing sector and, consequently, responses of individual organizations, particularly in terms of Green IT practices. Competitors, shareholders and customers apply cultural-cognitive/mimetic influences, while industry standards organizations and non-government organizations also bring normative pressures to bear on business enterprises (Campbell 2007). Normative and cultural-cognitive influences are more subtle in determining organizational responses towards environmental sustainability. Social expectations can be spread through firms by such links as trade associations and professional affiliation. This suggests external coercion to some degree. Cultural expectations of social actors play an important role in elevating concern about environmental issues to a level at which there are formal institutional pressures in the form of regulatory rulings or legal threats (Greening and Gray 1994). Environmental values can be disseminated through key institutions, which set standards, assess organizational practices in trade and professional publications, and serve as a platform for knowledge sharing and education (Chen et al. 2011). Chen et al. (2011) found positive relation between institutional pressure and adoption intensity of Green IT practices. However, Gholami et al. (2013) found mixed results when they separated institutional pressure as coercive and mimetic pressure whereby coercive has positive influence while mimetic does not. In this study, we regarded institutional pressure as one element and we focus on the effects of institutional forces (competitors, suppliers and customers, professional affiliation) on the adoption intensity of Green IT practices by businesses. Thus, the following hypothesis is formulated:

Hypothesis 1 Institutional pressure will be positively related to the adoption intensity of Green IT practices.

3.2 Individual perspective

Individuals working in organizations can play an important role in conveying the strategic importance of Green IS practices across the organization and resource allocations (Mithas et al. 2010). In particular, their positive attitude is necessary for Green IT practices to be

successful as they influence institutionalization of new patterns of behavior in several ways, starting from the influence on organizational policies and directives (Butler 2011). Unruh and Ettenson (2010) show that two-thirds of the executives in Toyota, GE, Timberland and Starbucks believe that the adoption of eco-sustainable initiatives is one source of revenue driver. Other studies (e.g. Liang et al. 2007) suggest that the success of IT systems needs investments of complementary resources in the organization, which is possible only when the individuals are committed and incorporate the IT implementation process in the broader strategies and activities of the organization. While investigating the relationship between environmental attitudes and behavior, Denis-Rémis et al. (2011) found that to encourage people to act environmentally, emotional appeal has a stronger impact than logical reasoning or factual description of harmful effects from environmental pollution. Chow and Chen (2009) in another study found the attitude toward green computing is the dominant factor explaining the belief or intention of IT users to practice green computing. Therefore, whether or not an organization takes Green IT practices seriously will depend on their employees' sentiment to environmental concerns (Molla and Cooper 2010). As a result, it is important to take into consideration the individual perspective. In this study, we thus focus on two individual traits i.e. CFC and openness.

3.2.1 Consideration of future consequences (CFC)

An individual's commitment towards Green IT initiates can be seen by assessing their consideration for future consequences (CFC). Personality psychologists interested in understanding self-control have long been interested in traits related to an individual's concern with immediate vs. future consequences (Strathman et al. 1994). Individual differences in considering future consequences reveal "the extent to which people consider the potential distant outcomes of their current behaviors and the extent to which they are influenced by these potential outcomes" (Strathman et al. 1994, p. 743). Individuals who attach a high degree of importance to the immediate consequences of behavior are low in CFC, while individuals who attach a high degree of importance to the future consequences of behavior are high in CFC (Joireman et al. 2008). It is believed that those with higher CFC would adopt practices that are more sustainable (Hevey et al. 2010) whereby adoption of Green IT would lead to a more sustainable environment (Chen et al. 2009). Commuting to work using public transportation is an example of sustainability practices and it was found that individuals high in CFC prefer commuting by public transportation and are especially sensitive to the perceived environmental impact of cars. In recent years, Gholami et al. (2013) discovered that managers high in CFC will be more likely to adopt higher levels of Green IS. Choon et al. (2014) in their study on students' intention to adopt Green IT found similar results. So we put forward the following hypothesis:

Hypothesis 2 Business managers high in CFC will be more likely to adopt Green IT practices with higher intensity.

3.2.2 Openness

The use of personality as an explanatory tool in the IS literature has increased over the years, and evidence from IS studies confirms that personality traits influence individuals to behave in certain ways across different situations and help us understand people's use of IT (Devaraj et al. 2008). IS research also uses personality traits to explain and predict users' behavior (Li et al. 2006). Openness represents a person's receptivity to new ideas and

experiences and has been related with an inquiring intellect, intelligence and intellectual interests (Korukonda 2007). Openness has also been used to explain people who are original, creative, curious, nonconformist, unconventional, sensitive, flexible, adventurous and broad-minded (Li et al. 2006). The effect of openness on people's interaction with technology has been an increasing focus of studies in recent years (e.g. Ashkanasy et al. 2007), with a variety of findings, including a positive association between openness and job satisfaction in an environment of continuing technological change (Gallivan 2004) and a negative association between openness and technophobia (Anthony et al. 2000). Li et al. (2006) demonstrated that the personality traits of openness to experience among chief information officers have a positive impact on their firms' innovative usage of IT. In addition, Colquitt et al. (2002) found that access to computer-assisted communication improved the decision-making performance of teams—but only when the teams consisted of people who were high in openness. The relationship between openness and Green IT adoption was examined by Choon et al. (2014) and they found there is a significant but weak relationship between the two variables. So, we propose the following hypothesis:

Hypothesis 3 The personality trait of openness is positively associated with the adoption intensity of Green IT practices.

3.3 Organizational performance

Companies are faced with difficult choices if they are to survive the dynamic environment and ruthless competition businesses face these days. The survival becomes more difficult during an economic downturn. Research has demonstrated that addressing sustainability issues such as adoption of Green IT is critical to the long-term existence of companies (Porter and Kramer 2006). In addition, the triple bottom line (TBL) approach describes sustainability in terms of three components: the natural environment, society (social) and economic performance (Elkington 1998). Thus organizational performance must be measured using indicators that reflect the effects on society and the environment, as well as economic indicators (Dao et al. 2011). Nidumolu et al. (2009) claim that when businesses can manage environmental issues successfully, superior economic performance and competitive advantage are possible. This view has gained increasing support as subsequent research has shown that organizations that adopt sustainable practices are rewarded in terms of increased economic performance i.e. profit and market share (Mithas et al. 2010). Subsequently, Unruh and Ettenson (2010) demonstrated that two-thirds of the executives in Toyota, GE, Timberland and Starbucks consider the adoption of Green IT initiatives to be one source of revenue drivers. Therefore, we hypothesized the following:

Hypothesis 4 The adoption intensity of Green IT practices is positively associated with economic performance.

Generally, environmental performance refers to reduction in waste, pollution and emissions, a decrease in the consumption of harmful materials and frequency of environmental accidents (Gimenez et al. 2012). Gholami et al. (2013) in their study found no relationship existed between Green IT adoption and environmental performance. However, Gimenez et al. (2012) found significant relationship between sustainable operations (such as Green IT practices) and environmental performance. As the evidence is inconclusive, we proposed to find out the relationship in the Iranian context. Thus, the formulation of the following:

Hypothesis 5 The adoption intensity of Green IT practices is positively associated with the environmental performance of the firm.

Society or social performance looks at internal communities (i.e., employees) and external communities (i.e. customers) within an organization Gimenez et al. (2012). This study focus on the external communities which is the customers as they are the reasons why organizations do business. One of the measure that can be used to measure customers outcome is through customers' satisfaction. Usage of sustainable technology such as Green IT may increase customers' satisfaction (Chen 2013). Customers are satisfied if the processes and products are environmentally sustainable. Thus, we proposed the following:

Hypothesis 6 The adoption intensity of Green IT practices is positively associated with customer satisfaction.

Based on the literature discussed above, we developed a research framework (Fig. 1) that identifies both the antecedents to, and the consequences of, the adoption intensity of Green IT practices.

3.4 Control variables

The nature of innovation adoption differs according to the size of the organization (Dardan et al. 2007). Smaller companies have a less sophisticated understanding of technical IT issues while larger organizations are usually in possession of more technology, finance and human resources. However, larger firms are also disadvantaged by "structural inertia"; that is, they tend to be less agile and flexible than smaller firms. In contrast, smaller firms are expected to be more innovative, as they require less communication, less coordination and less external influence to make decisions. Although SMEs often suffer from a lack of financial resources, they are usually quicker to adapt to meet new market needs (Zhu et al. 2006). We, therefore, include the firm size as a control variable in the research model.

As firms in different industry sectors have dissimilar needs, it appears that those in more information-intensive sectors are more likely to adopt IT than those in less information-intensive sectors. Firms in service industries (e.g., airlines, banking, courier services) which tend to have more information content in their products and services are more likely to utilize IT for competitive advantage than those in manufacturing settings (Thong et al. 2006). Thong et al. (2006) also found adopters of business to business (B2B) e-commerce from the manufacturing sector tend to encounter more inhibitors than other sectors. Industry characteristics could affect the intensity of adoption of Green IT practices. So, the type of industry is another control variable in this research.

4 Research method and data analysis

4.1 Procedures

The population of the study is Iranian companies listed on the Tehran Stock Exchange. We administered the questionnaires using an online survey. The targeted respondents were managers who handle IT adoption in companies listed on the Tehran Stock Exchange. This sampling frame is in line with prior research in this area (Benitez-Amado et al. 2010; Molla and Abareshi 2012). We extracted email addresses of the relevant respondents from firm websites and an invitation to participate in the online survey was sent to 1,150 managers in

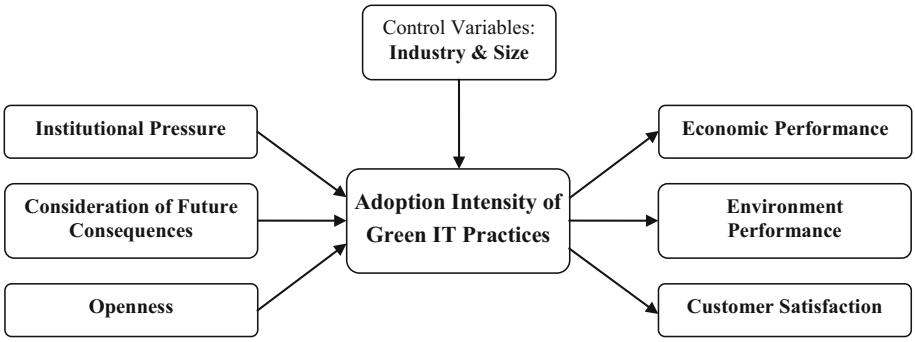

Fig. 1 Research model

1,150 firms. The invitation is directed to the CEO or General Manager of each firm. It is also indicated that they may pass the invitation to a manager (or equivalent position) in charge of IT adoption. Subsequently, two reminders were issued. In the end, a total of 277 usable responses from a cross section of industrial sectors were received, giving us a response rate of 19.74 %. The data were analyzed using Structural equation modeling (SEM) technique. SEM is appropriate for this study since being a multivariate technique it goes beyond multiple regression by being able to estimate inter-related relationships among variables simultaneously. This technique uses the confirmatory approach over the exploratory approach of data analysis and is the best multivariate technique to test construct validity and theoretical relationships between a set of concepts of interest (Hair et al. 2010).

4.2 Measurements

All the items in the questionnaire were adapted from relevant previous research (Chen et al. 2011; Dao et al. 2011; Hevey et al. 2010; Molla and Abareshi 2012). All question items were measured using a five-point Likert-type scale with anchors ranging from "Strongly disagree" to "Strongly agree". The questionnaire consisted of two parts. In Section One, 52 items were provided to tap the elements of the constructs. In Section Two, a variety of company profile data, such as number of employees and business activity, was collected.

4.3 Pilot study

Prior to distributing the questionnaire on a large scale, we conducted a pilot study to test the reliability of the measures. The questionnaire was distributed to 45 senior managers, of whom 31 responded with completed questionnaires. The data were analyzed using the SPSS v.16 and it was found that the Cronbach's Alpha values of all variables were above 0.7. Consequently, the questionnaire was considered to be reliable (Hair et al. 2010) and was thus distributed on a large scale.

4.4 Respondent profile

Table 1 presents the characteristics of respondents. As can be seen, there were more male respondents, and also more than half the respondents were above 40 years old. About two-

thirds of the respondents held university degree and had between 6 and 25 years of experience in their companies. Following the definitions, "The criteria to categorize small and medium-sized enterprises", provided by the Ministry of Industry, Mining and Commerce of Iran, this study defined medium and small enterprise (SME) as those companies where the number of regular employees does not exceed 250 persons. A large enterprise is one where the number of regular employees exceeds 250 persons. So, the sample of this study included 200 large enterprises and 77 SMEs. The valid questionnaires came from firms in more than 13 different sectors. 44 firms (15.9 %) operated in the manufacturing sector and 36 (13.0 %) in the construction and engineering industry. 33 firms (11.9 %) belonged to the petroleum and chemical sector and 30 firms (10.8 %) operated in the wholesale/retail sector, 27 (9.8 %) in finance, banking and insurance services and the rest (107 firms, 38.6 %) in other sectors. In addition, a high percentage of informants were ranked at the level of chief executive officer, chief information officer vice president or

Table 1 Characteristics of the respondent

Measure	Categories	Frequency	Percent
Gender	Male	212	76.0
	Female	65	24.0
Age	Below 30 years old	32	11.5
	31–40 years old	96	34.7
	41–50 years old	95	34.3
	Over 50 years old	54	19.5
Education	Undergraduate/First degree	123	44.4
	Master degree	59	21.3
	Professional degree	56	20.2
	Others	39	14.1
Job title	President/CEO/Vice-president	46	16.6
	Business/General manager	98	35.4
	CIO/MIS director/IT specialist	92	33.2
	Others	41	14.8
Working in this firm	Less than 6 years	56	20.2
	6–15 years	101	36.5
	16–25 years	93	33.6
	More than 25 years	27	9.7
Number of employees	Below 50 employees	14	5.1
	51–250 employees	63	22.7
	251–1000 employees	140	50.5
	Above 1000 employees	60	21.7
Firm's business activity	Manufacturing	44	15.9
	Construction and engineering	36	13
	Petroleum and chemical	33	11.9
	Trade: wholesale/retail	30	10.8
	Finance: banking/insurance	27	9.8
	Others	107	38.6

director of IT. This implies that the data obtained were from a reliable source in the company, as these groups of people are involved in policy making and have adequate knowledge pertaining to the adoption of Green IT practices and organizational performance.

4.5 Psychometric properties of the measures

The collected data were analyzed using structural equation modeling (SEM) which has been used in many recent studies (e.g. Vijande et al. 2013). However, before testing the hypotheses, we ensured that the measures used are valid and reliable. Thus, confirmatory factor analysis (CFA) was conducted using AMOS 16.0. The overall effectiveness of the measurement model was examined using four common measures of model fit: normed χ^2, goodness-of-fit index (GFI), comparative fit index (CFI), and root mean square error of approximation (RMSEA). The measurement model in the CFA was revised by dropping items that had larger standardized residuals than other items, one at a time. After removing three items (INP4, OPN5, and ENP7) the measurement model showed an overall good fit. The normed χ^2 was 2.257, which was below the maximum desired cutoff of 3.0. RMSEA was 0.061, indicating a good fit, below the maximum desired cut-off of 0.08. Also, CFI = 0.933 was above the recommended threshold of 0.90, suggesting that the measurement model fit the data adequately (Hair et al. 2010).

In the next step, convergent validity was examined using three measures: factor loading, composite construct reliability and average variance extracted (AVE). These measures are considered appropriate and have been used in some recent studies as well (Naqshbandi et al. 2014). The results of the convergent validity test are presented in Table 2. As can be seen, the total factor loadings of the items in the measurement model were greater than 0.70 and each item loaded significantly ($p < 0.01$ in all cases) on its underlying construct. Moreover, the composite construct reliabilities were within the generally accepted range of greater than 0.70. Finally, the average variances extracted were all above the recommended level of 0.50. As a result, all constructs had adequate convergent validity, according to the criteria recommended by Hair et al. (2010).

In addition, discriminant validity was tested to confirm whether the average variance shared between the construct and its indicators is larger than the variance shared between the construct and other constructs. The results of the discriminant validity test are presented in Table 3. As can be seen, all constructs share more variance with their indicators than with other constructs. After ensuring that the measures are psychometrically sound, we moved on to answering the objectives of this study by testing the hypotheses formulated above.

5 Hypothesis testing—structural model

We tested the structural model prior to testing the hypotheses. The findings of the SEM fit indices indicate that χ^2 was 2.617, which is below the recommended limit of 3.0. The RMSEA is 0.073, which is below the suggested cut off of 0.08, and the GFI (0.934) and CFI (0.952) are greater than recommended value of 0.90. In general, the hypothesized structural model provides an acceptable fit for the data. Adding more paths in the research framework does not significantly improve the fit. The residuals of the covariance were also small and centered near zero.

Table 2 Convergent validity test

Construct	Items	Factor loading	Composite reliability	Average variance extracted
Institutional pressure (INP)	INP1	0.825	0.818	0.642
	INP2	0.831		
	INP3	0.824		
	INP5	0.732		
	INP6	0.852		
	INP7	0.805		
Consideration of the future consequences (CFC)	CFC1	0.744	0.793	0.626
	CFC2	0.823		
	CFC3	0.830		
	CFC4	0.842		
	CFC5	0.836		
	CFC6	0.739		
	CFC7	0.765		
	CFC8	0.811		
Openness (OPN)	OPN1	0.851	0.826	0.659
	OPN2	0.873		
	OPN3	0.730		
	OPN4	0.826		
Adoption intensity of Green IT practices (GIT)	GIT1	0.821	0.834	0.648
	GIT2	0.746		
	GIT3	0.814		
	GIT4	0.869		
	GIT5	0.832		
	GIT6	0.843		
	GIT7	0.865		
	GIT8	0.792		
Economic performance (ECP)	ECP1	0.815	0.761	0.631
	ECP2	0.735		
	ECP3	0.820		
	ECP4	0.743		
	ECP5	0.812		
Environmental performance (ENP)	ENP1	0.814	0.825	0.652
	ENP2	0.833		
	ENP3	0.839		
	ENP4	0.785		
	ENP5	0.867		
	ENP6	0.811		
	ENP8	0.826		
Customer satisfaction (CUS)	CUS1	0.853	0.837	0.636
	CUS2	0.825		
	CUS3	0.846		
	CUS4	0.774		

Table 3 Discriminant validity test

Construct	INP	CFC	OPN	GIT	ECP	ENP	CUS
Institutional pressure (INP)	**0.801**						
Consideration of the future consequences (CFC)	0.46	**0.791**					
Openness (OPN)	0.52	0.49	**0.812**				
Adoption intensity of Green IT practices (GIT)	0.74	0.71	0.76	**0.805**			
Economic performance (ECP)	0.48	0.46	0.49	0.65	**0.794**		
Environmental performance (ENP)	0.56	0.53	0.57	0.75	0.58	0.**807**	
Customer satisfaction (CUS)	0.52	0.50	0.53	0.70	0.49	0.55	0.**797**

Diagonal figures indicate the square root of the average variance extracted between the constructs and their measures, while off diagonal figures are correlations among constructs

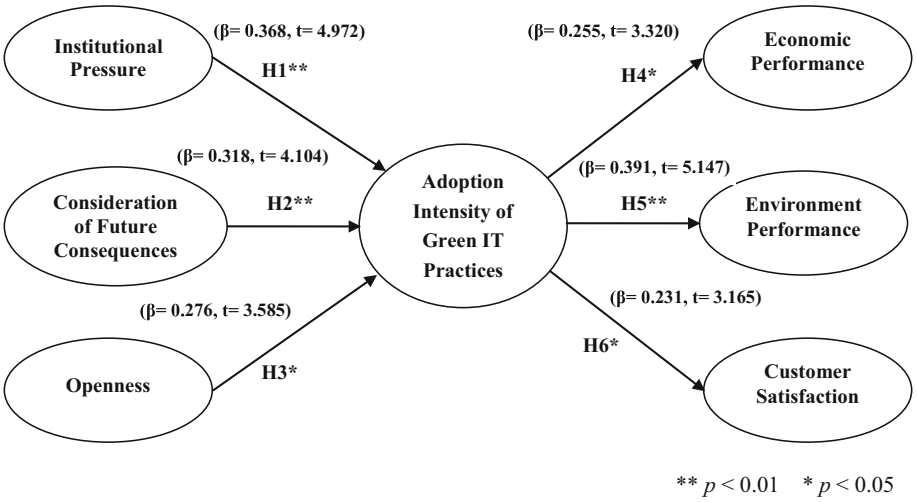

Fig. 2 Empirical results of the structural model

Figure 2 presents the standardized path coefficients and t-values that relate to the significant structural relationships among the tested variables. As can be seen, all of the hypotheses were strongly supported. The data indicates that Institutional Pressure has a direct effect on Adoption Intensity of Green IT Practices ($\beta = 0.368$, $p < 0.01$) which means that Hypothesis 1 is supported. The coefficient for the path from Consideration of the Future Consequences to Adoption Intensity of Green IT Practices is positive and significant ($\beta = 0.318$, $p < 0.01$) which supports Hypothesis 2. The data also indicates that Openness has a direct effect on Adoption Intensity of Green IT Practices ($\beta = 0.276$, $p < 0.05$) which means that Hypothesis 3 is supported. Consistent with our hypotheses, the findings indicate that Adoption Intensity of Green IT Practices has a direct effect on Economic Performance ($\beta = 0.255$, $p < 0.05$), Environmental Performance ($\beta = 0.391$, $p < 0.01$) and Customer Satisfaction ($\beta = 0.231$, $p < 0.05$) which means Hypotheses 4, 5 and 6 are all supported.

Table 4 Summary of findings

Hypothesis	Finding
Hypothesis 1: Institutional pressure will be positively related to the adoption intensity of Green IT practices	Supported
Hypothesis 2: Business managers high in CFC will be more likely to adopt Green IT practices with higher intensity	Supported
Hypothesis 3: The personality trait of openness is positively associated with the adoption intensity of Green IT practices	Supported
Hypothesis 4: The adoption intensity of Green IT practices is positively associated with economic performance	Supported
Hypothesis 5: The adoption intensity of Green IT practices is positively associated with the environmental performance of the firm	Supported
Hypothesis 6: The adoption intensity of Green IT practices is positively associated with customer satisfaction	Supported

Two control variables i.e. Size and Industry were considered in this study. The effect of the control variables was tested by introducing them one at a time as constraints into the research model and checking if the parameters of the constrained model are different from the unconstrained model. Neither of the two control variables is significant at the 0.05 level. It can be concluded that the size of the firms and their industry sectors are not significant determinants of the adoption intensity of Green IT practices. A summary of the results of this study is given in the Table 4.

6 Discussion

Tushi and Sedera (2014) conducted a review of 98 papers published on Green IT between 2007 and 2013 and recognized most studies tend to focus on developed nations, while a lesser number of studies gave consideration to developing nations. They suggested that the rise of major developing nations, each of which has burgeoning business opportunities featuring high level IT usage at the beginning of the 21st century, has brought with it an accompanying increase of environmental pressures. Hence, it becomes all the more imperative to have an expansion in the implementation of Green IT studies throughout the region. It will also be important to identify other up-and-coming developing nations where imminent industrialization will soon be adding to global environmental costs. (Tushi and Sedera 2014). Against this backdrop, we focused on Green IT practices in the context of Iran and obtained interesting results.

The findings of this research support the proposed hypothesis (Hypothesis 1) that there is a positive relationship between institutional pressure and the adoption intensity of Green IT practices. This result is consistent with results of prior studies (Butler 2011; Chen et al. 2011; Vykoukal 2010). The data implies that institutional pressure for environmental sustainability supports Green IT practices of businesses for the purpose of reducing overall emissions, overall waste and overall use of hazardous and toxic materials. In detail, the findings lead to the conclusion that pressure from customers and competitors for environmental sustainability has a positive effect on the adoption intensity of Green IT practices of businesses as a mean to decrease the environmental impact of the enterprise's

business and manufacturing processes. This is reasonable, because growing positive community awareness of Green IT practices forces businesses to implement IT infrastructure that is environmentally sound. In addition, the findings suggest that government regulations that attempt to reduce the environmental impact of business and manufacturing processes exerts pressure on firms to adopt Green IT practices. As Montalvo (2008) stressed, one of the major drivers of environmentally responsible behavior in industry is the involvement of government policy in the form of environmental policy and the enforcement of regulations. The application of public policies can range from direct command-and-control to voluntary programmes, with economic instruments somewhere along that spectrum. If government intervention takes the form of providing the right conditions and stimuli for firms, we can expect a positive relationship between regulation and the level of adoption of Green IT practices. So, it is recommended that regulations should create incentives for firms, to persuade them to develop consistent improvement of environmental performance.

The results of this research support the suggested Hypothesis 2, that there is a positive relationship between consideration of future consequences and the adoption intensity of Green IT practices. The outcomes of previous research (Ebreo and Vining 2001; Lindsay and Strathman 1997) confirm the result of present study. The study found that firm managers who are high in CFC attach a high degree of importance to the future consequences of environmental sustainability and consequently they tend to adopt Green IT practices. Managers need to sacrifice their immediate benefit or well-being in order to achieve a more sustainable environment in the future. Businesses and their managers need to be aware of short- and long-term harmful effects of their business on the environment and try to adopt Green IT practices to keep their environment green and clean. Businesses must inform their staff, and constantly remind them, about possible constructive and/or destructive impacts of their business processes on the environment and try to encourage them to adopt Green IT practices.

The outcomes of this study also support the proposed Hypothesis 3, that there is positive relationship between openness and adoption intensity of Green IT practices. This finding is consistent with findings of previous research (Ashkanasy et al. 2007; Korukonda 2007; Li et al. 2006). The study data indicate that the executives who score high on openness tend to display a proclivity to not only listen to new ideas, but also to change their own ideas and beliefs and consequently change their behavior as a result of new experiences and information. It also shows that chief information officers who are high in openness are more likely to initiate, implement and adopt Green IT practices in their organizations. As Qi et al. (2010) confirmed, firms planning to advance their environmental performance through the adoption of green practices need to have managers who have knowledge and concern about environmental issues. Thus, either training existing managers or the establishment of environmental knowledge requisites for new managers are important measures. In addition, understanding the significant role that managers play in the adoption of green practices, it is recommend that firms implement incentive mechanisms for managers who adopt and implement Green IT practices based on their environmental management performance. The incentives for such managers may motivate them to assign resources and effort towards environmental initiatives and to monitor environmental behaviors at lower organizational levels.

The results of this research also support the proposed Hypotheses 4, 5, and 6, that there is a positive relationship between adoption intensity of Green IT practices and economic performance, environment performance and customer satisfaction respectively. These findings also support the results of previous research (Dao et al. 2011; Mithas et al. 2010).

The results suggest that a firm's long-term profitability and existence are best served by balancing them against social and environmental goals and practices. Firms may use collaborative tools, telecommuting and video conferencing tools to reduce costs of travel. Furthermore, firms with higher levels of Green IT practices are likely to rationalize their production and operational processes to reduce environmental impacts. Rationalization involves reengineering 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. In addition, firms with higher levels of Green IT spending and practices can differentiate their products from those of their competitors based on their environmental friendly features.

Finally, the findings of this study did not indicate any significant differences in the adoption intensity of Green IT practices of enterprises among diverse type of industries and also among firms of different sizes. This is also in line with findings of prior research conducted in other countries (Benitez-Amado et al. 2010; Chen et al. 2011; Molla and Abareshi 2012; Vykoukal 2010).

It has to be highlighted here that although the findings are similar to previous studies, the context of the research differs, as this study conceptualized a model that indicates that adoption of Green IT practices is influenced by institutional pressure, consideration for future consequences and openness. Subsequently, the adoption of Green IT practices influences organizational performance.

7 Conclusion

Developed economies have arguably contributed significantly more to the carbon emissions of the past and because they will continue to be major polluters in the years to come, they bear responsibility for mitigating the environmental impact of their actions. At the same time, developing economies can learn from the mistakes of developed economies and take proactive measures to discharge their responsibility towards containing carbon emissions without jeopardizing their legitimate growth aspirations and prospects. Furthermore, to the extent green IT can lead to creation of new opportunities, it is in the interest of organizations in the developing economies to be proactive in implementing green IT initiatives (Enkvist and Vanthournout 2007).

Environment sustainability has recently attracted more attention among researchers and business practitioners. Beyond focusing on economic profit from business activities, enterprises also need to take into account the environmental and social impacts of their business activities. Doing so could actually help businesses reduce cost, raise profitability, sustain their market, achieve competitive benefit and become viable contributors to the market and society in the long-term. This research developed a framework for evaluating the adoption intensity of Green IT practices and empirically tested the model in the context of an Asian, developing country, namely Iran. The presented model examined the relationship between institutional pressure, consideration of future consequences and openness with the adoption intensity of Green IT practices and the relationship of the latter with economic performance, environmental performance and customer satisfaction.

The study has several implications for research. This research addresses the call for a body of empirical research that studies the factors influencing the adoption of Green IT practices (Dedrick 2010; Melville 2010; Molla and Abareshi 2012). The study therefore represents one of the few empirical studies on organizational adoption of Green IT

practices. The study provides an explanation of the reasons for the adoption intensity of Green IT practices. This research demonstrated that institutional pressure, consideration of future consequences and openness are all positively correlated with adoption intensity of Green IT practices. In addition, the outcomes of this study increase stakeholders' understanding in relation to the impact of adoption intensity of Green IT practices on economic performance, environmental performance and customer satisfaction. Furthermore, the research model of this study could be applied in other countries to check its applicability or for researchers interested in cross-cultural issues of adoption of Green IT practices.

Our study has implications for practice and managers as well. Managers can draw upon our framework to assess the conditions for Green IT usage and value creation. Our results will give decision makers in organization confidence that adoption of Green IT practices has the potential to affect firm performance through its impact on increasing product prices, growth in sales volume, cost savings, profit margins, market share or a combination of these, which are means to improving customer satisfaction and loyalty. Moreover, the study indicates that there are positive, tangible (economic performance) and intangible (environmental performance and customer satisfaction), gains linked with adoption of Green IT practices. As a result, when regulatory and market mechanisms are not strong enough to persuade managers to adopt Green IT practices, they are still likely to gain from investing in Green IT. Furthermore, the study confirmed that openness plays a positive role in adoption intensity of Green IT practices. For businesses that are keen to adopt Green IT practices to gain economic and environment advantage, it is vital that they recruit and develop managers who demonstrate openness in their character. In additionally, the findings of this study may be of interest to policy-makers. One initiative that policy-makers could undertake would be to provide managers with training and information about the importance of environment-friendly practices, specifically Green IT practices. This would at least reassure managers that environment-friendly practices cause no problems with economic performance and are likely to yield valuable economic and environmental performance improvements, as confirmed by Molina-Azorín et al. (2009). Finally, our findings may also have some implications for Green IT vendors. For example, the sales teams of Green IT vendors can target their efforts to sell new green technology primarily at managers who are open in the organization. These executives are more likely to be receptive to new ideas and Green IT practices and technologies.

In addition, it is proposed that organizations formulate a Green IT strategy to incorporate practices which will allow them to remain environmentally sustainable. Among the practices that can be implemented without much effort are collaborative technologies, such as video and teleconferencing, enterprise carbon and emission management systems and energy informatics systems. Practices such as turning off the system when not in use, using screen savers and using thin-client computers should be embedded as part of the organization's work culture as prescribed by Murugesan (2008).

A number of limitations of this research open avenues for future studies. First, given the fact that this study has been carried out in Iran, caution must be exercised when generalizing the findings to other social, economic and cultural contexts. Future studies on other countries would investigate whether the model utilized in this study was applicable in other environments. Second, given the cross-sectional nature of research design, this study focuses on the simultaneous effects of the independent variables on the dependent variable. Future studies could take a longitudinal approach to reveal the interactive operation of the independent variables over time. Third, this study measured economic performance and environment performance using subjective measures. This was due to the difficulty of obtaining the relevant, accurate data from the companies. It is recommended that potential

researchers should use some quantifiable measures and compare their findings with the outcomes of this research. Lastly, this study was conducted by investigating a large number of common Green IT practices across a variety of industries. Future research could focus on a particular industry. The findings based on industry-specific Green IT practices may provide more insights into industrial heterogeneity in relation to the adoption of Green IT practices. Alternatively, future researchers could investigate emerging Green IT practices, which may not exist or have gained popularity when the present research was conducted.

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