Challenges for ‘Green IT’ in the Scottish ADM industry

Edgar, David; Duncan, Peter; grant, kevin; Hackney, Ray

Published in:
Proceedings of SIG Green Pre-ICIS 2016 Workshop

Publication date:
2016

Document Version
Author accepted manuscript

Challenges for ‘Green IT’ in the Scottish ADM Industry

Abstract

Our research reports specifically on the challenges and behaviours towards ‘Green IT’ experienced within one complex industry. We adopt a theoretical stance based upon Unified Theory of Acceptance and Use of Technology (UTAUT) to formulate an outline ‘Green IT’ agenda. We draw on historical thinking which underpins UTAUT, which can be traced back to the theory of reasoned action (TRA) and the frequently adopted technology acceptance model (TAM). Recent research on the business case for a green IT strategy identifies benefits to an enterprise’s revenue and/or cost rather than just its image making. In this respect, empirical evidence was collected and analysed from the Aerospace, Defence and Marine (ADM) industry in Scotland which includes over 800 companies employing nearly 40,000 staff which creates Gross Value Adding to the Scottish economy of around £2 billion. Data collection involved an on-line based semi structured questionnaire to all 180 Aerospace and Defence organisations using the Scottish Enterprise Database. Our findings suggest a need to develop unified measurements to evaluate green IT progress. Specifically, these should include a metric capable of measuring IT companies’ net environmental activism, assessing not only the impact of changes but also on the operations and products of their clients.

Keywords: Green IT, UTAUT, Aerospace, environment.

Introduction

There is evidence of a growing trend by companies to promote ‘care for the environment’ within their ethical and corporate social responsibility strategies. Moreover, adopting a strategic approach to environmental issues may, potentially, be a source of competitive advantage (Esty and Winston, 2006). As part of this ‘green agenda’, there is an awareness that information technology (IT) contributes to negative environmental impacts but also provides potential solutions (Kuo and Dick, 2009). The exploratory research in this paper explores the balance between ‘lean’ and ‘green’ with regard to IT. The main features of ‘Green IT’ and the technology sustainability agenda is still embryonic (Esty and Winston, 2006) and may be defined as “a collection of strategic and tactical initiatives that directly reduces the carbon footprint of an organisation’s computing operation” (O’Neill, 2010, p4). The terminology has been integrated into many previous research studies (including OECD; Malhotra et al, 2013; Butler and Hackney, 2015). Green IT does not have a universal definition, but is more an ethos, which is becoming commonly adopted in policy and practice beyond reducing energy consumption and carbon footprint of the IT function. The topic looks more widely at the whole energy landscape including electricity, emissions, recycling, chemicals, water, digital Gross National Product, transportation means, infrastructures, and building controls, etc. However, we focus upon one aspect of the green IT agenda through an empirical analysis of ‘energy consumption’.

The United Kingdom (UK) Government, in particular, have been discussing the issue of carbon footprints and Green House Gas emissions and have passed a number of policies, which have already affected organisations to reduce emissions produced (Bradford and Fraser, 2007). For example the NI 185 CO2 reduction from Local Authority operations or the Carbon Reduction Commitment (CRC) Energy Efficiency Scheme (2010). Many of these ‘solutions’ have been enabled by IT via technologies such as: motion detection and control; light detection and control; fleet management systems; traffic management systems; smart metering; resource pooling; and e-services (Booz and Company, 2010). However, it is only a matter of time before Small to Medium size Enterprises (SMEs), which make up the largest proportion of business in the UK (99.3% according to Federation of Small Business), will also be required to reduce their carbon footprints. Within the UK, the Scottish Parliament has set a strategic aspiration to position itself as a leading edge advocate of green technology and to be a pioneer in the green global agenda. This strategic aspiration was noted by John Swinney (Cabinet Secretary for Finance, Employment and Sustainable Growth), in March 2009:

> “*The transition towards a low carbon economy presents both a challenge and major opportunity for Scotland. Scotland has already taken a lead with the most ambitious emission reduction targets in the world. The transition of Scotland’s*

industries and firms to low carbon products and services is both an economic and environmental imperative and offers the potential to stimulate and exploit rapidly expanding global markets." (Swinney, 2009, p2).

Much of the existing work surrounding the IT sector tends to concentrate on data centre advanced cooling systems for servers, virtualization, power management software and thin clients (Booz and Company, 2010) and latterly in developing more 'green' base systems, i.e., the use of innovative building design. Green House Gas emissions are only one part of the whole picture in reducing environmental damage, indeed some research estimates suggest that IT and all the related peripherals such as data centres, etc account between 2 and 5% of the worlds 'green house gas' production (Aebischer and Hilty, 2015).

Although concern with Green IT is growing there has been relatively little research undertaken generally and more specifically within one industry (Jenkin et al, 2011, Gholami et al, 2016). Similarly, there is a dearth of literature regarding SMEs relating to 'green management' (Lee, 2009) and Green IT (Parker et al, 2010). There has not been any empirically based research into Green IT within Scottish SMEs in relation to the impact of the green agenda on how such SMEs manage and think about IT/IS as mechanisms to understand and promote their green credentials. As such, this paper seeks to address this gap. The research aim is therefore to explore awareness and implications of Green IT in aerospace and defence suppliers (SMEs) within Scotland.

Developing a Green IT strategy

The importance of implementing strategies and procedures to ensure that businesses do not cause unnecessary harm to the environment has never been such an important an issue as it is now. The International Standards for Organisation (ISO) developed a framework in which business could adopt an audit procedure called ISO 14000 (MacDonald, 2005). ISO 14000 is by no means the only environmental management system; it is however, the most popular and the only environmental management system, which can be certified by an external certification authority, but there is no requirement by law to adopt it. As contemporary organisations 'power up' with regards to environmental awareness and stewardship, they are repositioning themselves towards using green power supply, recycled paper, moving energy intensive operations to locations that are suitable for clean energy; and so on (Olson, 2008). Much has been done on image making, rather than looking at using the green agenda to drive down costs and to promote benefits. Indeed, Olson (2008), based on survey of large American based firms, refers to these and similar initiatives as an 'enterprise level green strategy' and argues that such a strategy has a potential positive impact on the environment. However, the business case for green strategy should identify benefits to an enterprise's revenue and/or cost rather than just its image making. Building on the work of others, Jenkin et al (2011) suggests there are four types of Green IT strategy, as noted in Table 1.

Strategy Type	
Type 0	Image-oriented only
Type 1	Prevent, control, eco-efficiency
Type 2	Product stewardship, eco-equity
Type 3	Sustainable development, eco-effectiveness

Table 1: Green IT Approaches **(**adapted Jenkin et al., 2011, p23)

Olson (2008) stated that the basis for implementing a Green IT strategy lies within the culture that has been created within an organisation. He noted that along with the companies' chief executive teams (CEO, CIO and CFO) there will be in the near future a CGO (Chief Green Officer) sitting at the table discussing important environmental impacts that the organisations have (Olson, 2008). Olson's (2008) paper is targeted more for the larger firms, with much larger budgets and does not refer to small businesses. It is useful to illustrate a proposed strategic planning framework by Olson (2008), as noted in Figure 1.

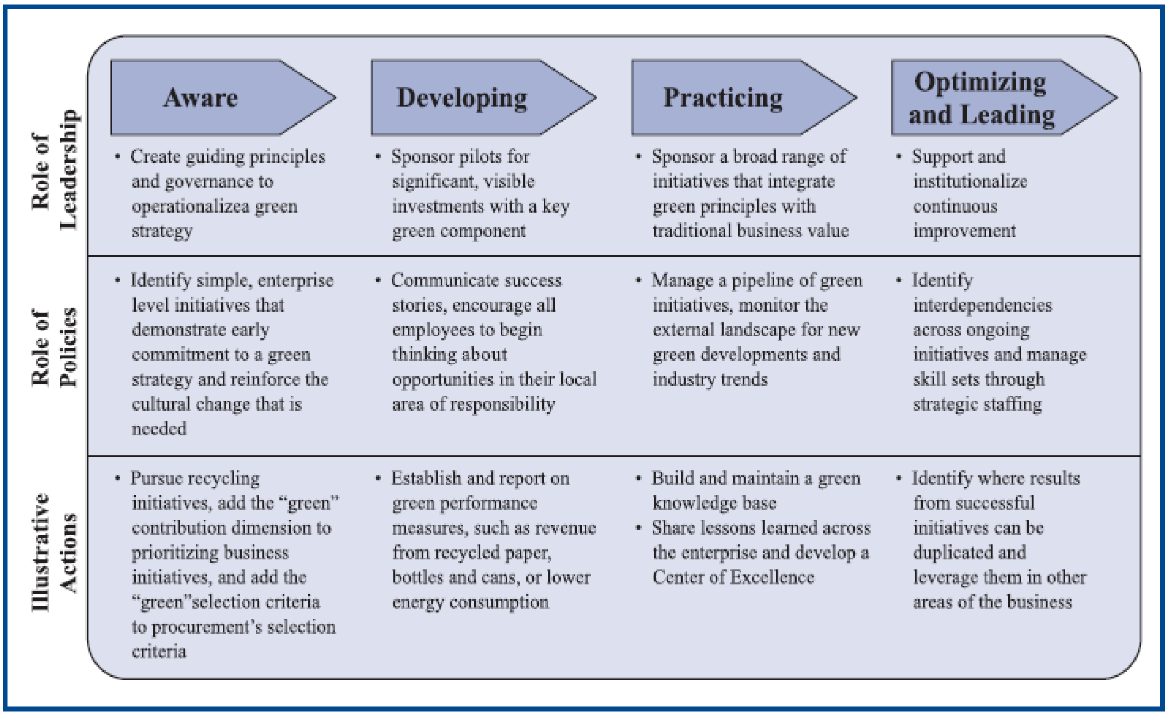

Figure 1: Green Strategy Maturity Model (Olson, 2008, p28)

While this model enables organisations to look at their current adoption of green practices, there are a number of issues with it. Firstly, there is no real mention of IT or IS within the framework. This despite the author being a consultant for a large IT firm and in the context of environmental usage. Secondly, there is no mention how the maturity framework was created or devised and what organisations were used to test the concepts on. The number of Green frameworks like this are limited, hence the need for further development and research into this area. Chen et al (2008) stated that in order to fulfil 'eco-effectiveness', users need to measure themselves using IT systems, which would be an easy first step in utilising IT in a 'Green' manner. However, Chen et al's (2008) paper was entirely based on prior research, and no study of organisations was used, while this is not a particularly negative point, the majority of sources are pre 2000, and since Green IT is a relatively new subject, up to date sources would be more appropriate. Reasons for having a Green IT approach are: to reduce power consumption (75% of responses), lower unit costs (service and product) (73%), lower carbon emissions and environmental impact (56%), space savings (47%) (Murgesan, 2008), but the question as to are these reasons valid for SMEs remains unanswered. Given the embryonic nature of the research evidence, a simple synthesis can be determined and posited. Namely organisations can, conceptually, view 'green IT' from a sourcing perspective, from an operations perspective and finally from a life cycle perspective in reusing, recycling and disposing IT hardware.

Industry Sector and Research Context

Aerospace, Defence and Marine (ADM) Scotland includes over 800 companies with involvement in AD and M, employing nearly 40,000 staff. Scotland has a strong background in advanced engineering, including R and D, design and manufacturing. Aerospace, Defence and Marine is a key high technology sector, with an experienced skills base. Aerospace, defence and marine sales in 2009 were over £5 billion. The industry creates Gross Value Adding to the Scottish economy of around £2 billion. The Scottish ADM sector includes a number of global industry companies, including defence companies such as SELEX Galileo, Thales, Raytheon and BAE Systems and aerospace manufacturing and MRO (maintenance, repair and overhaul) companies such as Rolls-Royce, GE Aviation, Spirit AeroSystems, Goodrich, Woodward, Teledyne and Vector Aerospace. In addition, there is a growing range of Scottish-owned companies in the aerospace and defence sectors (Scottish Enterprise, 2010).

The 180 ADM SMEs in Scotland collectively employ around 16,200 people and over 500 apprentices (Scottish Enterprise, 2009). This generates around £2.28 billion in sales, making it the World's largest Aerospace and Defence industry after America (Scottish Enterprise, 2009). Therefore, this industry's importance to the UK economy is extremely high, and the technological equipment they use, from manufacturing systems to computer screens is extensive. Bradford and Fraser (2004) noted that if SMEs were to reduce their environmental impact, then collectively they could reduce the UK's overall impact on the environment.

Theoretical Perspectives

For this research a 'greener' version of the well known, Unified Theory of Acceptance and Use of Technology (UTAUT) developed by Venkatesh, et al (2003), was developed. Much of the thinking which underpins UTAUT, can be traced back to the theory of reasoned action and the technology acceptance model. Historically, Ajzen and Fishbein (1980) developed a versatile behavioural theory and model called the Theory of Reasoned Action (TRA) (TCW, 2004). TRA suggests that a "person's behaviour is determined by his or her intention to perform the behaviour and this intention is, in turn, a function of his/her attitude toward the behaviour and his or her subjective norm" (Ajzen,1980; Legris et al, 2003). It is apparent that the "intention is the best predictor of behaviour. Intention is the cognitive representation of a person's readiness to perform a given behaviour, and it is considered to be the immediate antecedent of behaviour" (Ajzen,1980; Legris et al, 2003). There are two main intention determinants in TRA: (a) attitude toward behaviour (ATB) and (b) subjective norm (SN) related to that behaviour. According to TRA, "attitude toward behaviour is defined as a person's positive or negative feelings about performing a specific behaviour and can be determined by one's beliefs that performing the behaviour will lead to various consequences multiplied by the subjective evaluation of those consequences" (Davis et al, 1989). Subjective norm (SN) is the "social pressure applied on the person or the decision maker to perform the behaviour. SN refers to an individual's perception about what other people think of his or her behaviour in question" (Legris et al, 2003). TRA is a general well-researched intention model that has been extensively used in predicting and explaining behaviour across many domains and virtually any human behaviour (Ajzen et al, 1980).

Technology Acceptance Model (TAM) attempts to predict whether a new technology would be accepted within a business or social group. It has been suggested that this model can be used to explain how users adopt new technology and that the key to increasing the usage of new technology is concerned around assessing what the end user will perceive as valuable and what they will use the IT application for. Attitude is determined by perceived ease of use (PEOU) and perceived usefulness (PU). It can be suggested that TAM has replaced TRA's influencing attitude through "perceived ease of use". It is generally found that "TAM specifies general determinants of individual technology acceptance and therefore it could be used to explain or predict individual behaviours across a broad range of end user computing technologies and user groups" (Davis, et al 1989). While being both theoretically justified and parsimonious, the goal of TAM is to explain the determinants of technology acceptance of users, by explaining user behavioural intention (Davis, et al 1989).

The TAM theorises that perceived usefulness and perceived ease of use, mediate the effects of external variables, such as training, system characteristics, development process, on intention to use the system (Venkateshet al, 2000). Perceived usefulness is also influenced by perceived ease of use (Venkatesh et al, 2000). The theory assumes that usage of a particular technology is voluntary (Davis, 1989). Another assumption is presented that if an individual is given enough information regards to a particular activity and is allowed time to understand the technology then behavioural intention closely matches the way that they actually behave (Ajzen et al., 1980; Han, 2003). Furthermore, related to TAM are strong behavioural elements; it is suggested that when an individual "forms an intention to act, they will be free to act without limitation" (Ajzen et al., 1980). However, in day-to-day life many barriers will prevent this from occurring for example "time constraints and limited ability" (Bagozzi, 1992). Finally, TAM3 (Venkatesh, et al, 2008) has been developed. However, it returns to the more technical nature of the 'system', rather than the concept, thus the justification of what authors refer to as a Green Unified Theory of Acceptance and Use of Technology has only built upon TRA and TAM.

The proposed Green Unified Theory of Acceptance and Use of Technology (GUTAUT) takes the eight elements contained in the UTAUT, but has reconfigured them towards a more green perspective. The GUTAUT still contains the theory of reasoned action, the technology acceptance model, a motivational model, the theory of planned behaviour, a model combining the technology acceptance model and the theory of planned behaviour, a model of PC utilization, innovation diffusion theory, and social cognitive theory. GUTAUT has four core determinants of intention to use a technology, and up to four moderators of key relationships. Using the existing UTAUT four core models holds four key constructs to play key role as direct determinants of usage intention and usage behaviour:

1) Performance expectance, in the UTAUT, now becomes **End User Efficiencies (EUE)** in the 'greener' version
2) Effort expectancy, in the UTAUT, now becomes **Enterprise IT Efficiencies (EITE)** in the 'greener' version
3) Social influence, in the UTAUT, now becomes **Lifecycle and Procurement (LAP)** in the 'greener' version
4) Facilitating conditions, in the UTAUT, now becomes **Enabling the Business (ETB)**in the 'greener' version
5) E-waste (defined below) being added to the GUTAUT;
6) Product Stewardship(defined below) being added to the GUTAUT;
7) Product Leasing (defined below) being added to the GUTAUT

Gender, age, experience and voluntariness of use are the key moderators in UTAUT and have been adopted to the GUTAUT. Self-efficacy, attitude toward using technology, and anxiety are theorised that they do not have direct influence on intention, in this case to embrace green IT.

Research Methodology

Data collection involved an on-line email based semi structured questionnaire, using SurveyMonkey, to all 180 Aerospace and Defence organisations using Scottish Enterprises Database. Researchers in the area have attempted to predict and explain user behaviour across many IT domains. The main aim of these studies has been to investigate how to improve usage and examining what inhibits usage and intention to use the technology. Theoretical models on user acceptance of IT (e.g. online banking) specify "intension to use" and "actual use" as the key dependent variables (Venkatesh, et al 2003). Every prominent technology acceptance theory or model has its own areas of strength and weaknesses. After allowing for undeliverable emails (i.e. businesses either not trading anymore, or email addresses no longer valid (12%), the overall response rate was 27% (49 companies). While this is low, the vast majority of the email addresses sent links to the questionnaire were to the Managing Directors and IT or Operations Directors', therefore the data received is from influential or elite sources.

Prior to the survey the data collection instrument was validated through pre-testing. We selected 11 respondents including 3 students, 3 lecturers, 2 information technology staff, 2 general staff and 1 managerial staff from a Scottish University. The survey data was electronically imported into a statistical software package, SPSS (Statistical Package for Social Sciences) version 15, and then cleaned for analysis and graphical presentation of the results. Construct reliability measures the stability of scale based on internal consistency of items measuring the construct. The reliability of the constructs was measured using Cronbach's alpha. All the values were above 0.70, the common threshold values recommended in the literature. All the internal consistency reliabilities were higher than 0.80 (Table 2).

Measurement Items	Cronbach's Alpha	Reliability Result	Inter-item Correlation
End User Efficiencies (EUE): The use of technologies, techniques, and practices at the end user or client level to reduce energy consumption and the carbon footprint. These include thin client computing, printer rationalisation and consolidation, and low watt PCs and peripherals.	0.863	Good	0.541-0.714
Enterprise IT Efficiencies (EITE): The use of technologies, techniques and practices in the data centre or at the server level, or across the enterprise, to reduce energy consumption and the carbon footprint. These include virtualisation and other server consolidation techniques, facilities management and other practices.	0.828	Good	0.428-0.676
Lifecycle and Procurement (LAP): The	0.818	Good	0.368-0.766

adoption and use of energy reduction, sustainability and green strategies in the IT procurement and lifecycle management process. It includes recycling and waste disposal strategies and practices.			
Measuring and Monitoring: (MAM) the use of IT tools and techniques to ensure the business is measuring and monitoring its energy consumption and carbon footprint. That includes software-based energy consumption measurement tools, PUE and DCiE, and NGERS and CPRS compliance techniques.	0.888	Good	0.592-0.720
Enabling the Business (ETB): The use of IT to improve the efficiency and to reduce the energy consumption and the carbon footprint of the business as a whole. It includes supply chain management efficiencies, telecommuting, teleconferencing and videoconferencing, increased use of collaboration tools, etc.	0.880	Good	0.473-0.838
E-waste (EW): is "electronic waste. It includes a broad and growing range of electronic devices from large household appliances such as refrigerators, air conditioners, hand-held cellular phones, personal stereos, consumer electronics and computers. E-waste is hazardous, and it is generated rapidly due to the extreme rate of obsolescence. E-waste contains over 1,000 different substances, many of which are toxic, and creates serious pollution upon disposal. These toxic substances include lead, cadmium, mercury, plastics, etc." (Gaulon, et al 2005).	0.906	Good	0.647-0.751
Product stewardship (PS): is "a principle that directs all participants involved in the life cycle of a product to take shared responsibility for the impacts to human health and the natural environment that result from the production, use, and end-of-life management of the product" (Product Stewardship Institute 2004).	0.824	Good	0.386-0.780
Product Leasing (PL) Leasing externalises the costs of process wastes and product disposal, placing the burden on the OEMs, who gain from reducing these costs. Product leasing results in closed material loops, promotes remanufacturing or recycling, and sometimes leads to shorter life cycles (Intlekofer, et al 2010)	0.884	Good	0.577-0.714

Table 2: Summary of Cronbach's Alphas, Reliability Result and Inter-item Correlation

Research Findings

The businesses were asked if they thought their company's IT usage was set to increase, decrease or remain the same over the next three years. Out of the 42 that responded to the question, 68% of the respondents felt their IT usage is set to increase, and 31.8% said it was to remain the same, none of the businesses said it was to decrease. This is not a surprising result, as the vast majority of businesses will grow their IT usage and is in line with Bradford and Fraser's (2004) view, supporting the need for a 'Greener" outlook on using IT should not feature on the strategic agenda. In order to assess the importance, or even how applicable Green IT would be to these companies; they were asked what types of IT their company used (Figure 2)

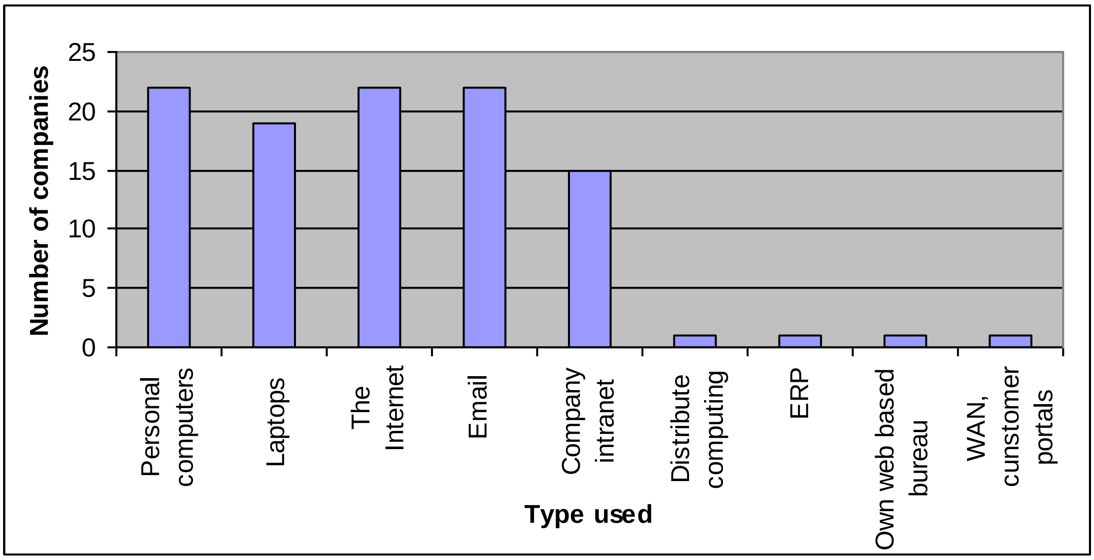

Figure 2: Type of IT equipment used

Figure 2 shows that all the companies who answered that question use IT systems that have the potential to be made 'Greener' in some form. This, along with the fact that their companies' IT usage will be increasing or remaining the same, means that if 'Green' initiatives were to be adopted, then it could have a positive impact on the organisations. To understand how the industry view Green IT principles, they were asked to rate eight factors influencing their companies' decision to adopt a Greener use of technology. There was an even spread of attitudes for some of the issues, namely the lack of staff knowledge and the lack of government advice for Green IT. However, un-surprisingly the vast majority stated that the cost of changing over systems to make them Greener was a very important factor, which coincides with Vesilind et al's (2006) view that the cost of new Green initiatives will be a very large factor for SMEs. For the majority of the firms, this is definitely the case, as 36% spend less than £10,000 on IT; what is interesting however is that 31% spend over £40,000, which would indicate several of the firms view IT as paramount to the company's strategy and completely vital to the organisation.

The firms were also asked to rate 'Green' IT concepts; this was to ascertain what they felt to be good use of IT in an environmental fashion. Again, there was a wide spread of responses, however the most popular concepts were Teleconferencing, Quicker booting up procedures for computers and network lighting detection to switch lights off when there is no people in the room. Only ten respondents said that five of the Green concepts were bad or 'not appropriate', which may be due to their firm not requiring any of those procedures (Figure 3).

Using the above ideas as examples of 'Green' IT strategies, does your company use any of these, or anything similar?	% of Respondents
Unsure	5.26%

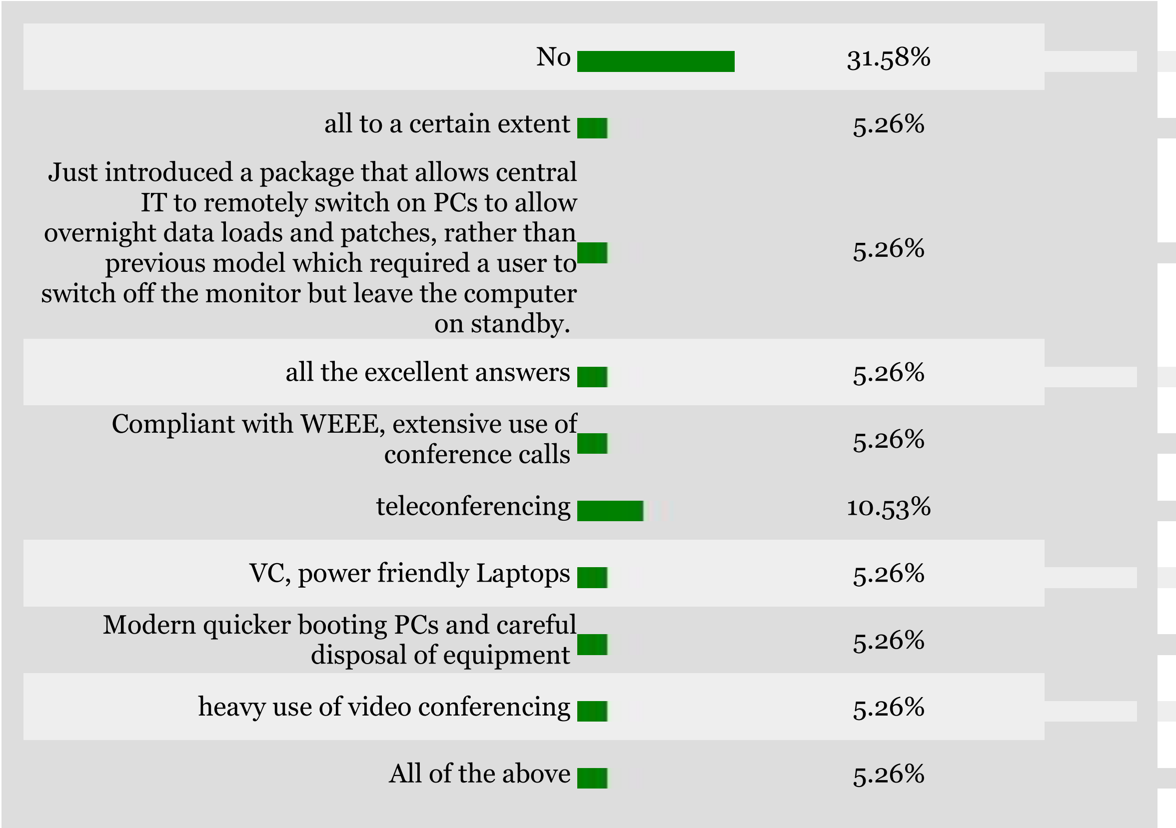

Figure 3: Green IT Strategies

Intention to develop 'Green IT' Policies – Mean and Std. Deviation

Gender	Mean	Std. Deviation
Male	3.808	2.0142
Female	3.593	2.1000
Age		
18-29	3.511	2.1959
30-39	4.068	1.9016
40-49	3.859	1.8016
50-59	4.150	.4743
>59	4.000	.0000
Education		
High school or below	3.100	2.1435
College/Undergraduate	3.538	2.1990
Masters degree	4.274	1.6688
Above Masters	3.827	1.6059
Technology (IT) Experience		
Less than 2 years	3.250	2.3717
2 – 5 years	3.411	2.2577
6-10 years	3.875	2.0559
Above 10 years	3.924	1.6623

Table 3: Intention to develop 'Green IT' – Mean and Std. Deviation

Correlation Matrices

In order to assess possible correlation between variables, Pearson coefficient of correlation was computed for all variables, shown in Table 3. The Pearson coefficient is a parametric technique and is so widely used that often the word ‘correlation’ by itself refers to it (Hussey and Hussey, 1997). Although this technique presumes interval data, its use for ordinal data is common – although this remains a matter of some debate (Bryman and Cramer, 1997). The correlations among constructs (EUE, EITE, LAP, MAM, ETB, EW, PS and PL) were significant ($p<0.05$) at the 0.01 level (2-tailed), except between ETB and LAP (Table 4).

		Gender	Age	Education	Occupation	Internet Experience	Intention to use Green IT	ETB	EW	PS	PL
Intent to Use	Pearson	-.051	.099	.135	.145*	.108	1	.151**	.190**	.247**	.216**
	Sig. (2-tailed)	.370	.080	.017	.010	.056		.007	.001	.000	.000
EUE	Pearson	-.005	.142*	.174	.158	.133	.345	.249*	.518**	.503*	.414**
	Sig. (2-	.926	.011	.002	.005	.018	.000	.000	.000	.000	.000
EITE	Pearson	.038	.184*	.259	.234	.185	.178	.323*	.479**	.416**	.435**
	Sig. (2-	.507	.001	.000	.000	.001	.002	.000	.000	.000	.000
LAP	Pearson	-.039	-.108	-.048	-.094	-.093	.101	.032	.281**	.356**	.255**
	Sig. (2-	.490	.055	.398	.096	.100	.076	.576	.000	.000	.000
MAM	Pearson	-.062	.013	.069	.073	.014	.235**	.393*	.406*	.413**	.493*
	Sig. (2-tailed)	.272	.820	.219	.195	.808	.000	.000	.000	.000	.000

Table 4: Correlations among constructs

End User Efficiencies (EUE)

H1: The influence of end **User Efficiencies (EUE)** *on behavioural intention to use green related IT will be moderated by* ***gender*** *and* ***age****, such that the effect will be stronger for men and particularly for younger men.* There was a positive correlation between the two variables user efficiencies and behavioural intention to use green IT [$r=0.345$, $p=0.000$]. Increases in user efficiencies were positively correlated with increases in behavioural intention to use green IT. However, the figure shows that gender does not moderate the user efficiencies on behavioural intention to use green IT. However, the result does suggest that higher user efficiencies is positively associated with higher intention to use green IT, under conditions of older aged men. Therefore, the first hypothesis is partly accepted.

Enterprise IT Efficiencies (EITE)

H2: The influence of **Enterprise IT Efficiencies (EITE)** *on behavioural intention to use green related IT will be moderated by* ***gender, age, internet experience*** *and* ***education****, such that the effect will be stronger for women, particularly younger women, and particularly in their early* *stages of technology experience, particularly with increasing education*. There was a positive significant correlation between the two variables EITE and behavioural intention to use green IT [r=0.178, p=0.002]. Increases in effort expectancy were positively correlated with increases in behavioural intention to use green IT. However, the figures show that age, internet experience and education do not moderate the EITE on behavioural intention to use green IT, but the gender does moderate and the effect is stronger for women. Therefore, the second hypothesis is partly accepted.

Lifecycle and Procurement (LAP)

H3: The influence of **Lifecycle and Procurement (LAP)** *on behavioural intentions to use green related IT will be moderated by **gender, age** and **occupation**, such that the effect will be stronger for men, particularly older men, particularly in higher professionals*. There was no significant positive correlation between the two variables life cycle and procurement and behavioural intention to use green IT [r=0.101, p=0.076]. Increases in life cycle and procurement were not significantly correlated with increases in behavioural intention to use green IT. Further, the results show that there is no significant moderation by gender, age or occupation. Therefore, the third hypothesis is rejected.

Measuring and Monitoring: (MAM)

H4: The influence of **Measuring and Monitoring: (MAM)** *on behavioural intentions to use green IT will be moderated by **gender, age, occupation, internet experience** and **education**, such that the effect will be stronger for men, particularly older men, and particularly in their early stages of technology experience, particularly with increasing education*.There was a significant positive correlation between the two variables measuring and monitoring and behavioural intention to use green IT [r=0.235, p=0.000]. Increases in measuring and monitoring were positively correlated with increases in behavioural intention to use green IT. However, the results show that the occupation does not moderate the measure and monitor to intention relationship but the relationship is stronger for women, particularly younger aged, with high technological experience and lower education. Therefore, the fourth hypothesis is partly accepted.

Enabling the Business (ETB)

*H5: The awareness of **Enabling the Business (ETB)** will influence the behavioural intentions to use green IT*. There was a significant positive correlation between the two variables enabling the business and behavioural intention to use green IT [r=0.151, p=0.007]. Increases in awareness of service were positively correlated with increases in intention to use green IT. Therefore, the fifth hypothesis was accepted.

E-waste (EW)

H6: That **E-waste (EW)** *will influence the behavioural intentions to use green IT*. There was a significant positive correlation between the two variables E-waste and behavioural intention to use green IT [r=0.190, p=0.001]. Increases in reducing E-waste were positively correlated with increases in intention to using green IT. Therefore, the sixth hypothesis was accepted.

Product stewardship (PS)

H7: The perceived benefit of **Product stewardship (PS)** *will influence the behavioural intentions to use green IT*. There was a significant positive correlation between the two variables product stewardship and behavioural intention to use green IT [r=0.247, p=0.000]. Increases in product stewardship were positively correlated with increases in intention to use green IT. Overall, the seventh hypothesis was accepted.

Product Leasing (PL)

H8: That the concept of **Product Leasing (PL)** *will influence the behavioural intentions to use green IT*. There was a positive correlation between the two variables product leasing and behavioural intention to use green IT [r=0.216, p=0.000]. Increases in product leasing were positively correlated with increases in intention to use green IT. Therefore, the eighth hypothesis was accepted.

Conclusion

Our exploratory research has considered the environment of organisations with respect to their approach to designing and implementing Green IT initiatives. It is believed to be unique to apply a research effort in this respect within a specific organisational context (ADM) and to adopt a quantitative methodological approach to formulate conjectures of planned behaviours. A critical finding is the need to devote resources, increase awareness, incentivize managers and to encourage collaboration towards Green IT strategies. There is also a need to develop unified measurements to evaluate progress. Specifically, this should include a metric capable of measuring IT companies' net environmental activism, assessing not only the impact of changes to their own operations and products but also their impact on the operations and products of their clients. It is evident that organisations should adopt a long-term plan, involve all constituents and be conscious of the embryonic nature of Green IT opportunities and constraints.

References

Aebischer B and Hilty L M, 2015. The Energy Demand of ICT: a historical perspective and current methodological challenges. In ICT Innovations for Sustainability, pp. 71-103, Springer International Publishing

Ajzen, I., and Fishbein, M., 1980. *Understanding Attitudes and Predicting Social Behaviour, Prentice-Hall*, Englewood Cliffs, NJ

Bagozzi, R, P., 1992. "The Self-Regulation of Attitudes, Intentions, and Behaviour", *Social Psychology Quarterly,* Vol 55, IS 2, pp. 178-204.

Bradford J, Fraser E., 2007. "Local Authorities, Climate Change and Small and Medium Enterprises: Identifying Effective Policy Instruments to Reduce Energy Use and Carbon Emissions". *Corporate Social Responsibility and Environmental Management*. Volume 15, pp 156-172

Booz and Company, 2010. Demystifying Green IT Seeding Advantage (perspectives by Hugo Trepant, Ramez Shehadi and Danny Karam)

Butler, T. and Hackney, RA. 2015. "Understanding Digital Eco-innovation in municipalities: an Institutional Perspective" , *ECIS2015*. Munster, Germany. 29 - 29 May

Chen, A. Boudreau, M., Watson, R. 2008. "Information Systems and ecological sustainability". *Journal of Systems and Information Technology*. Volume 10, No. 3, pp 186-201

Dao, V., Langella, I. and Carbo, J, 2011. "*From Green to Sustainability: information technology and an integrated sustainability framework"*, Journal of Strategic Information Systems, Vol. 20, pp. 63-79

Davis, F. D. 1989. "Perceived usefulness, perceived ease of use, and user acceptance of information technology", MIS Quarterly, Vol 13, IS 3, pp 319–340

Esty, D. C. and Winston, A. S, 2006. *Green to Gold: how smart companies use environmental strategy to innovate, create value, and build competitive advantage*, John Wiley and Sons, New Jersey, USA.

Gholami, R; Watson, R T, Hasan, H, Molla, A, Bjorn-Andersen, N, 2016. "*Information Systems Solutions for Environmental Sustainability: how can we do more?"*, Journal of the Association for Information Systems: Vol. 17: IS. 8, Article 2

Greenpeace (No date), Greenpeace/apple [Site archived] [Online] URL: http://www.greenpeace.org/apple/ Accessed 15/10/11.

Jenkin, T. A., Webster, J. and McShane, L, 2011. "*An Agenda for 'Green' Information Technology and Systems Research*, Information and Organization", Vol. 21, pp. 17-40.

Kuo, B. N. and Dick, G. N, 2009, "The Greening of Organisational IT: what makes a difference?", *Australasian Journal of Information Systems*, Vol. 16, No. 2, pp. 81-92.

Legris, P., Ingham, J., & Collerette, P. 2003. “Why do people use information technology? A critical review of the technology acceptance model”. Information & Management, 40(3), pp. 191-204

Lee, K.-H, 2009, Why and how to adopt green management into business organizations? The case study of Korean SMEs in manufacturing industry, *Management Decision*, Vol. 47, No. 7, pp. 1101-1121.

MacDonald J, 2005. “Strategic sustainable development using the ISO 14001 Standard”. *Journal of Cleaner Production*. Volume 13, 2005, pp 631-643

Malhotra, A. , Malhotra, C.K. and See, A. 2013. “How to crate brand engagement on Facebook”, MIT Sloan Management Review, Vol. 54 No. 2, pp. 18-20.

Murugesan, S. 2008. Harnessing Green IT: Principles and Practices‖, *IT Pro* (Jan/Feb.), pp. 24–33.

Olson, E. G. 2008. "Creating an Enterprise-level "Green" Strategy." *Journal of Business Strategy* (29:2), pp. 22-30.

O’Neill, M. G, 2010. *Green IT for Sustainable Business Practice: an ISEB foundation guide*, British Informatics Society Ltd., Chippenham, UK.

Parker, C. M., Fraunholz, B., Zutshi, A. and Crofts, M, 2010. “How do Australian small and medium enterprises communicate their environmental activities online?”, *Australasian Journal of Information Systems*, Vol. 17, No. 1, pp. 5-21.

Swinney, J., 2010. Towards A Low Carbon Economy For Scotland: Discussion Paper, The Scottish Government, ISBN: 978-0-7559-9268-3

Venkatesh, V.; Davis, F. D. 2000. "A theoretical extension of the technology acceptance model: Four longitudinal field studies", Management Science, 46 (2): pp. 186–204,

Venkatesh, V. 2000. "Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model", Information systems research, 11 (4), pp. 342–365

Venkatesh, V.; Morris, M. G.; Davis, G. B.; Davis, F. D. 2003. “User acceptance of information technology: Toward a unified view”, MIS Quarterly, 27 (3): pp. 425–478

Venkatesh, V.; Bala, H. 2008. "Technology Acceptance Model 3 and a Research Agenda on Interventions", Decision Sciences, 39 (2): pp. 273–315