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The Green IT Working Paper Series discusses ideas and research results on the role of information and communications technologies in ecological sustainability.

Paper No. 1

GREEN IT DIFFUSION: AN INTERNATIONAL COMPARISON

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with

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Abstract

This paper provides a preliminary insight on the status of the diffusion and maturity of "Green IT" as well as some of the driving and inhibiting factors that influence it. The report is largely descriptive and is based on a survey of 143 organisations from Australia, New Zealand and the USA.

Overall, the findings indicate that organisations are developing the "right mind-set", taking a number of "softer actions"; and investing in new technologies to use IT as part of the solution to pursue both eco-efficiency and eco-sustainability objectives. Nevertheless, the state of Green IT among the surveyed organisations can be considered at the early stage of maturity. In particular:

- *The results indicate that disposal of IT in an environmentally friendly manner is the most relevant organisational concern about Green IT. It is therefore not surprising that there is significantly more attention paid to policy and practice in the end-of-IT-life management aspect of Green IT. On the other hand, attention to Green IT sourcing is the least adopted.*
- *The need for greater IT efficiency and the pursuit of tangible cost savings from IT operations are the primary drivers for adopting Green IT which has to be articulated in the strategy of an organisation. Likewise, the cost of Greening IT and unclear business values from Greening IT top the list of the factors that inhibit Green IT adoption. This implies that as IT budgets continue to shrink, IT managers may turn to Green IT only if Green solutions are affordable and yield tangible and near term cost savings. Thus, of all the items used to assess Green IT, server virtualisation and consolidation have the widest uptake. Many believe that server virtualisation can produce quick–win cost reduction.*
- *In less than half of the cases reported, the role for coordinating Green initiatives is defined and CIOs are taking a leading role in all Green (IT and non IT) initiatives. However, in the majority of organisations, IT is not yet responsible for its own electricity costs and there are no well developed metrics for assessing the impact of Green IT initiatives. Hence, executives might not know the tangible returns from implementing Green IT.*
- *Limitation of the small sample size withstanding, the findings of this study hint at differences in Green IT initiatives among US, New Zealand and Australian organisations. In Australia and New Zealand, environmental consideration is the primary concern. In US the primary concern appears to be energy efficiency and cost reduction. Thus, while Australian and New Zealand organisations are leading the 'softer" side of Green IT policies and practices to reduce the environmental impact of IT, US organisations are far more advanced in the adoption of technologies and practices that reduce energy consumption and improve efficiency. This might be because of differences in the scale of IT operations. Generally US organisations have larger IT shops.*
- *Despite the initial steps, most CIOs believe that their organisations lack an adequate level of readiness for Green IT.*

Acknowledgements

The research has benefited from inputs of the members of the Green IT research team at the School of Business Information Technology, RMIT - Dr. Vanessa Cooper, Prof. Hepu Deng, Dr. Konrad Peszynski and Dr. Say Yen Teoh.

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1. INTRODUCTION

The advance of information and communication technologies (ICTs) based business and social practices in the last few decades has transformed many, if not most, economies into e-economy and businesses into e-business. For economies, ICTs are increasingly playing critical roles in transforming and generating economic opportunities. On the other hand, global warming and climate change coalescing with limited availability and rising cost of energy are posing serious challenges for the sustainability of the global digital (or otherwise) economy. Technology has a potential to create sustainable business and society both in grim and green economic times. Especially, the recovery from the current economic crisis is going to need and lead to more Greener and energy efficient industries. It is in this wider context of the technology–sustainability linkage that "Green IT" has emerged as one of the top issues of concern for IT and business managers.

Two major but inter-related streams of Green IT thoughts can be identified. On the one hand, each stage of the IT lifecycle from manufacturing to usage and disposal has environmental implications- *ICTs as part of the problem*. Estimates indicate that ICTs account for 2% of global CO2 emissions, which is equivalent to the amount the aviation industry generates. In addition, ICTs might have had the undesirable consequence of increasing the expansion of environmentally polluting business undertakings. Further, electronic-waste is emerging as one of the fastest growing wastes filling landfills. On the other hand, ICTs can be deployed to tackle the environmental footprint of a business- *ICTs as part of the solution*. This role of ICTs can range from enabling a carbon footprint analysis, monitoring and reporting capability through supplanting eco-unfriendly business practices to deploying computerized models to increase energy efficiency and reduce Greenhouse gas emissions.

The purpose of this report is to provide a preliminary insight on the status of the diffusion and maturity of "Green IT" as well as some of the driving and inhibiting factors that influence it. The report is largely descriptive and is based on a survey of 143 organisations from Australia, New Zealand and USA.

2. DEFINING GREEN IT

Green IT means many things to different people. It is neither a well defined concept nor a uniformly accepted set of practices or technologies. In defining Green IT and assess its diffusion, we sought to promote a wider understanding of Green IT-one that captures the two themes (*problem and solution*) of Green IT; one that covers the IT-activity chain from sourcing to end-of-IT-life management; and one that will enable us to capture not only the hard technologies but also the soft business policies and practices. Green IT can therefore be defined as follows:

> *Green IT is the [systematic] application of criteria related to environmental sustainability to the design, production, sourcing, use and disposal of IT within an organisation.*

Thus defined, it is possible to identify two dimensions of Green IT- *Green IT Reach* and *Green IT Rich*. *Green IT Reach* refers to the extent to which Green IT is permeating an organisation's IT activity chain from *sourcing* through *operations* to *end-of-IT-life management*. Firms' responses to environmental challenges vary. While some might just have environmental policies for public consumption, others Green-wash their strategies through recycling practices. Still others might approach Greening IT through either selective or comprehensive strategy making significant investment in Greening their technological infrastructure. *Green IT Richness* therefore refers to the extent of maturity of Green IT *polices, practices and technologie*s. The combination of the two dimensions forms a "Green IT Reach-Richness Matrix".

The Green IT Reach-Richness Matrix

Green IT Reach Dimensions : Cradle-to-Cradle (Breadth)	Green IT Rich Dimension – PPT (Depth)			
		Policies	**Practices**	**Technologies and systems**
	Sourcing	The extent to which an organisation has articulated a guideline (s) for an environmentally preferable purchasing of IT.	The practice of analysing the Green track record of IT hardware, software and services providers, incorporating Green considerations in IT procurement decisions.	Information systems that track, monitor and analyse the carbon foot print of suppliers such as supplier sustainability assessment tools.
	Operations	Encompasses the extent to which Green issues are encapsulated in policy frameworks governing the development and use of the IT assets and infrastructure of an organisation.	Green IT operation practices refer to eco-considerations in operating the IT and network critical physical infrastructure in data centres and beyond and operational actions designed to improve the energy performance of corporate IT assets.	New technologies and systems for (a) reducing the energy consumption of powering and cooling corporate IT assets (such as data centres) (b) optimizing the energy efficiency of IT assets (c) reducing IT induced Greenhouse gas emissions (d) supplanting carbon emitting business practices and (e) analysing a businesses total environmental footprint.
	End of IT life management	End of IT life management policy	Practices in reusing, recycling and disposing IT hardware	Information systems that track the disposal of IT in an eco-friendly way.

Maturity in Green IT Reach and Richness can demonstrate the depth of a firm's Green IT strategy and commitment to the main goals of eco-sustainability- *pollution prevention, product stewardship* and *use of clean technology* (Hart, 1997). A combination of organisational motivation and institutional forces can influence the breadth and depth of Green IT adoption. Such factors can help to gauge a firm's approach to sustainability - *eco-efficiency, eco-effectiveness and eco-equity* (Chen et al, 2008).

3. RESEARCH METHOD

Data for this study were collected through a survey of organisations between December 2008 and March 2009.

Australian and New Zealand sample were drawn from a database rented from IncNet Australia whereas US samples were drawn from the Top Computer Executives database. The database providers assured 80% delivery. The main contact person was a CIO or its equivalent.

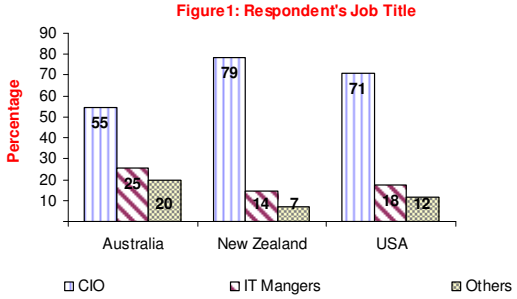
After initial screening of the rented databases, a total of 2153 CIOs or their equivalent (951 Australian, 202 New Zealand and 1000 US) were invited to complete the on-line survey. The initial invitation was followed with three rounds of reminders. A total of 784 contacts bounced back because of delivery failure, out of office bounce back or invitees' declining to complete the survey.

A total of 146 responses were received. Three were unusable hence removed from the analysis leaving 143 usable responses (95 Australian; 14 New Zealand and 34 US).

4. PROFILE OF SURVEY PARTICIPANTS

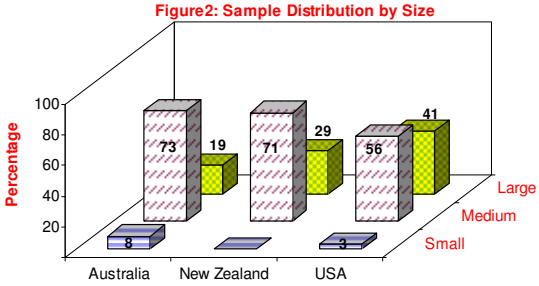
Most of the respondents (83%) were Chief Information Officers or IT (systems, infrastructure, and information) Managers (Figure 1). Others held job titles such as Enterprise Architect, Software Development Manager, Office Manager, IT Coordinator, Directory of Sustainability and IT Group Leader.

Figure1: Respondent's Job Title



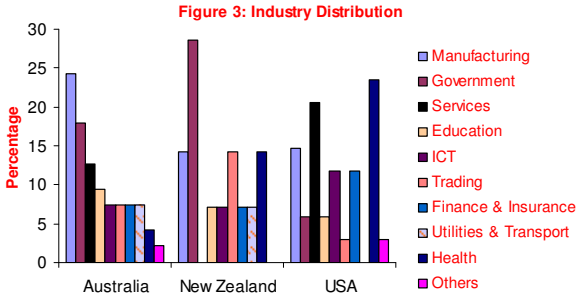
While 69% classify their organisational size as medium and 24% as large, the remaining were small (Figure 2). Australian and New Zealand respondents were mostly from medium sized organisations, whereas US respondents were from medium (56%) and large organisations (41%).

Figure2: Sample Distribution by Size



In terms of industry distribution (Figure 3), most respondents were from manufacturing (21%), government (16%) and services (13%) sectors. The rest were distributed across health (10%), finance and insurance (8%), ICT (8%) and education (8%). Nearly a quarter of the respondents from Australia were from the manufacturing sector. On the other hand, almost one-third of respondents from New Zealand and just under a quarter of US respondents were from government and health sectors respectively.

Figure 3: Industry Distribution



Participating firms differ in terms of their IT profile (Figures 4-7). Forty one percent of all respondents operate IT shops with less than 50 servers, 20% between 50 and 150 and 34% more than 150 servers. However, US respondents have a relatively larger IT operation both in terms of server (85% more than 150 servers, Figure 4), personal computers (85% more than 1000, Figure 5) and IT staff head counts (78% more than 100, Figure 6) and annual operational budget (average 54 million USD).

Figure 4: Number of Servers

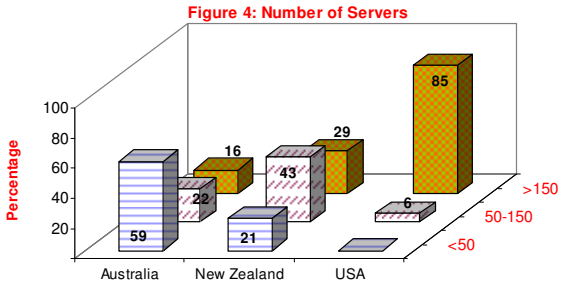
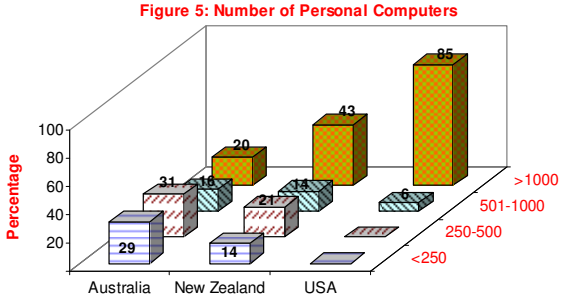


Figure 5: Number of Personal Computers



One medium size Australian Manufacturing company has only one server, 13 personal computers and annual IT spend less than AUD 10,000. On the other hand, a large Finance and Insurance firm has 1000 servers, 40,000 personal computers and reported to spend AUD one billion annually on IT operational budget.

From the USA sample, a large firm in the ICT sector has 50,000 servers, 10,000 personal computers and annual IT budget of 300 million US dollar. From the New Zealand sample, the largest IT operation is represented by a manufacturing firm with 1000 servers, 13,000 personal computers and 150 million NZ Dollars annual IT spend. Sixty percent have outsourced (Figure 7) between 1 -20% of their IT operations.

Figure 6: Number of IT Staff

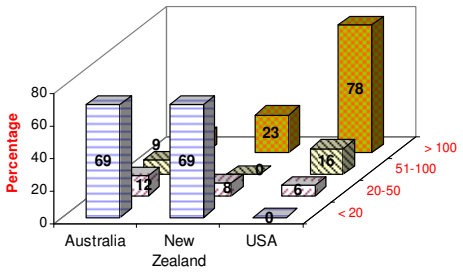
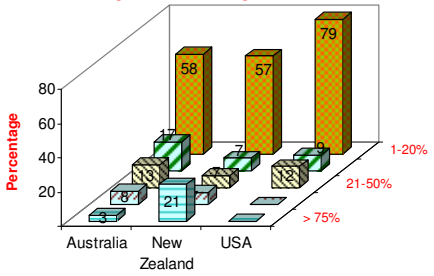


Figure 7: Percentage of Outsourced IT Work



5. THE RELEVANCE OF GREEN IT

Organisations generally pursue three goals of eco-sustainability- *pollution prevention, product stewardship and use of clean technology* (Hart, 1997). The findings of this research indicate that pollution prevention at the end-of-IT-life is the primary goal for most respondents (Figure 8). The adoption of recycling practices can reduce the level of toxic materials going to land fills but does not necessarily show changes in IT use processes. CIOs are therefore exploring other Green IT goals intended to reduce IT's emissions, achieve energy efficiency and use IT to tackle their overall environmental footprint. In particular:

- Nine out of ten rank procurement of cleaner and Greener IT as either very important or somewhat important. Clean technologies can lead to significant changes in the business process and their adoption is intended to reduce the level of environmental impact along a product's life cycle from design to consumption.
- Almost four-fifth of respondents say that IT's role to tackle carbon emitting business practices is relevant to their business
- US respondents are particularly keen on energy and cost-saving Green IT initiatives and they perceive the relevance of all aspects of Green IT relatively higher than their peers in Australia and New Zealand.

Figure 8: Reducing electronic waste dominates the goal of greening IT

What aspect of Green IT is relevnat to your business?

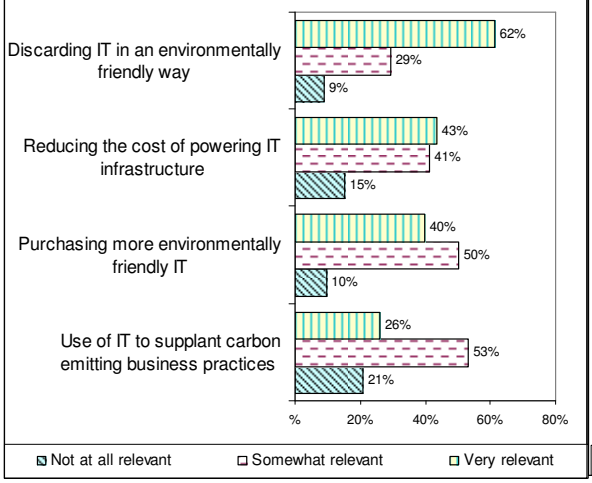
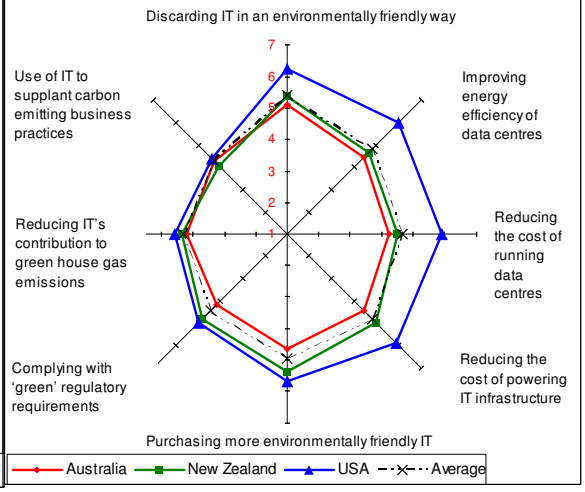
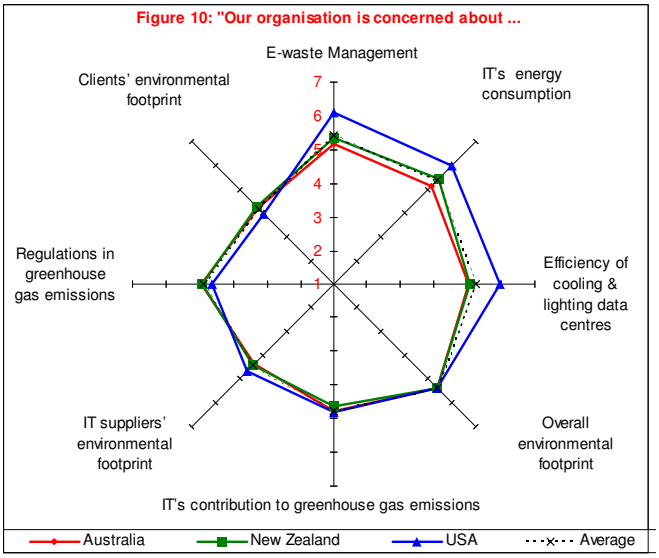


Figure 9: US respondnets perceive the relevance of Green IT higher than Australian and New Zealand



6. THE PERVASIVNESS OF GREEN IT AWARENESS

Greening IT naturally starts with IT and business leaders' sentiments towards climate change, energy efficiency, emission reduction, pollution prevention and overall environmental footprint.

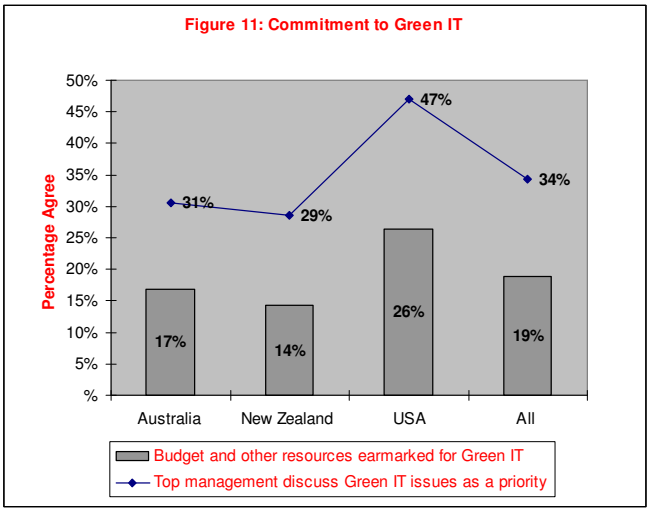


E-waste management and IT's energy consumption (80% agree and mean=5.4) are the top two concerns among respondents (Figure 10). Most respondents (77% agree) are also concerned about the efficiency of cooling and lighting their data centres (mean=5.3) and their businesses' environmental footprint (mean=5.4). In the first three cases, there is a significant difference between US (mean=6.1, 6.0, 5.9 respectively) and other respondents with US taking the lead.

65% of the organisations (68% Australian; 64% New Zealand and 56% US) are concerned (either to some or great extent) about IT's contribution to Green house gas emission (mean=4.87), the rest do not consider it as an issue.

Australian organisations are relatively more concerned (68%) than New Zealand (57%) and USA (56%) about the impact of emerging regulations on Green house gas emissions. Overall, there is relatively less concern across the three countries regarding suppliers' (mean=4.4) and client's (mean= 4.2) environmental footprint.

While firms in the finance and insurance sector appear to be more concerned about the efficiency of powering data centre physical infrastructures, those in the utility and logistics give more attention to their clients' carbon footprint.



Organisational size on its own doesn't seem to influence attitude towards Green IT. However, there is a strong association between IT size (measured by the number of servers) and Green IT issues. Indeed as the server size increases, an organisation's concern to pollution prevention and product stewardship appears to increase correspondingly. This implies that organisations with larger server farms and data centres might lead the adoption of Green IT technologies and practices.

The relevance of Green IT and organisation's positive attitude to reduce, reuse and recycle can be expected to transfer to real commitment towards Green IT. However, most organisations have yet to earmark budget for Green IT (Figure 11). While Green IT is featured as a top management priority agenda in nearly 50% of US organisations, it does so in only one third of Australian and New Zealand organisations.

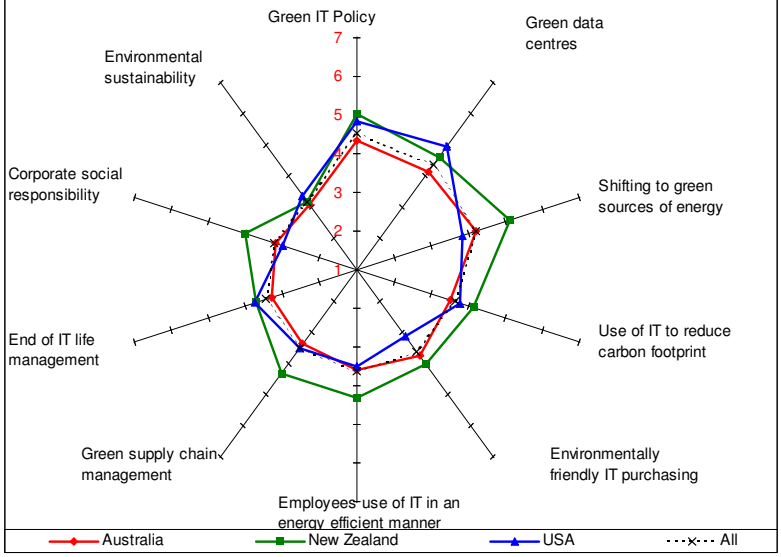
7. THE MATURITY OF GREEN AND GREEN IT POLICIES

Policy refers to the extent to which Green and sustainability guidelines are developed across an organisation and permeate the IT value chain.

We tracked (Figure 12) the level of development of nine policy frameworks covering IT (sourcing, operation and disposal) and non-IT areas. Overall, policy frameworks to guide both Green strategy and Green IT have yet to fully mature among the respondent organisations.

The top two relatively matured policy items are corporate social responsibility (mean 4.5) and e-waste management (mean 4.0). On the other hand, the least matured policy frameworks are use of IT to reduce a business's carbon footprint and Green IT itself, however defined (mean 3.2).

Figure 12: The Maturity of Green Policies



Forty percent of respondents (41% Australian, 43% New Zealand and 35% US) do not have a policy framework earmarked as "Green IT" (mean=3.2). Such a policy framework is well developed only in 7% of the cases and somewhat developed among the remaining. Fifteen percent have a well developed environmentally friendly IT sourcing policy (mean=3.6) and in 55% of organisations it is somewhat developed and in 30% it is yet to develop. In terms of end-of-IT-life management, while 27% have a well developed policy and in another 55% it is developing, 18% do not have such a policy at all.

Although US respondents appear to lead in Green IT awareness, organisations in New Zealand are leading in terms of many of the environmental sustainability policy frameworks. However, this trend changes when it comes to Green IT and Green data centre policies, where the US appears to be taking the lead. The extent of policy development is less mature in Australia.

Excepting policies that influence using clean energy sources, which is relatively matured amongst the transport and utilities firms, there is no significant difference in policy framework across industries. Policy frameworks are, however, well developed in organisations with larger server farms.

There is significant and positive correlation among the different policy items (Figure 13). The magnitude is stronger among generic Green policies and those policies specifically addressing IT issues. This implies that the development of CSR, Green supply chain and environmental policies might not always be associated with the development of policies intended to Green IT. The strongest correlation is observed between use of IT to reduce a business carbon emission and Green data centres (0.80) and Green information technology (0.79) policies.

Figure 13: Correlations

		A	B	C	D	E	F	G	H	I
A	Corporate social responsibility	1								
B	Green supply chain management	**0.70**	1.00							
C	Environmental sustainability	**0.69**	**0.76**	1.00						
D	Shifting to green sources of energy	0.47	0.65	**0.68**	1.00					
E	Environmentally friendly IT purchasing	0.44	0.64	0.49	0.59	1.00				
F	Green data centres	0.41	0.61	0.44	0.56	**0.78**	1.00			
G	Use of IT to reduce carbon footprint	0.47	0.67	0.52	0.59	**0.70**	**0.80**	1.00		
H	Employees' use of IT in energy efficient way	0.44	0.55	0.44	0.53	**0.72**	**0.72**	**0.77**	1.00	
I	End of IT life management	0.42	0.44	0.31	0.36	0.56	0.52	0.52	0.57	1.00
J	Green information technology policy	0.37	0.61	0.40	0.53	**0.70**	**0.73**	**0.79**	**0.72**	0.55

**. Correlation is significant at the 0.01 level (2-tailed).

8. THE MATURITY OF GREEN IT PRACTICES

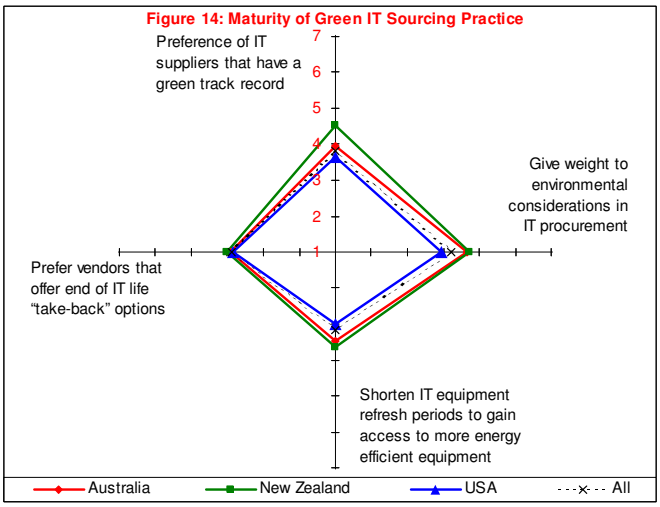
Policy captures the strategic dimension of Green IT. However, not all policies can be expected to be implemented smoothly nor are all practices expected to be strategy led. Green IT practice assesses the pervasiveness of Green practices that contribute to Greening IT at an operational level. It also measures to what extent an organisation has translated its concerns and policies into actions. The level of diffusion of a number of Green IT practices covering the sourcing, operation and end-of-IT-life dimensions were assessed.

Green IT Sourcing Practice

As some organisations are adopting environmental considerations in IT procurement and IT vendor evaluation decisions, Green IT sourcing practices are getting some acceptance (Figure 14). While 25% and 16% of respondents always prefer IT vendors that offer take-back options (mean=3.9) and that have a Green track record (mean=3.8) respectively, another 55% and 53% do so sometimes. Only a handful of respondents (6%) are shortening their refresh periods to gain access to more energy efficient equipment (mean=3.17).

Organisations in New Zealand lead Green IT sourcing practices compared to Australian and US. The difference is statistically significant when it comes to the extent of giving weight to environmental considerations in IT procurement (43% to a great extent in New Zealand; 13% Australia and 32% US). The majority of New Zealand respondents were from the government sector. The New Zealand government's procurement policy framework states that purchasers should be guided by the principle of "*requiring sustainably produced goods and services wherever possible, having regard to economic, environmental and social impacts over their life cycle*". This could be a response to the small size of the New Zealand economy and to the simple government structure of New Zealand with only one layer of Australia and the US with three and the corresponding ambivalence between the layers about responsibility.

Figure 14: Maturity of Green IT Sourcing Practice



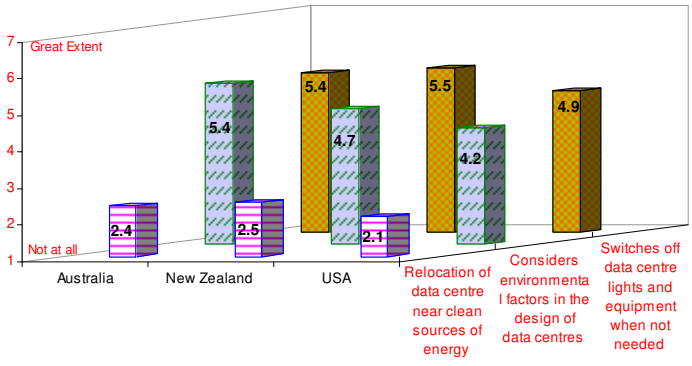
Green IT Operations Practices

Green IT operation practices can range from eco-considerations in operating the IT and network critical physical infrastructure in data centres to operational actions designed to improve the energy efficiency of corporate IT infrastructure.

In data centre practices (Figure 15), only 29% always switch off lights and equipment even when not needed and 13% do not at all do so.

Environmental factors are, however, always considered by 42% of organisations in the design of data centres and another 51% do so to some extent. About 8% of respondents have relocated their data centres near clean sources of energy.

Figure 15: Green Data Centre Operation Practice

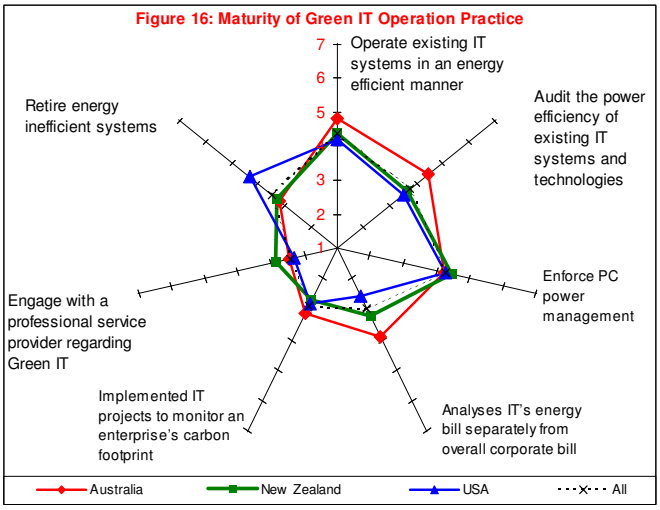


Beyond data centres, a number of actions to improve IT's energy consumption and encourage eco-friendly IT operation are getting practiced (Figure 16). The most common all of these practices is to operate existing IT systems in an energy efficient manner (mean= 4.4; 19% great extent and 70% to some extent). However, as 54% of respondents (60% Australian, 50% New Zealand and 38% US) do not know how much IT is contributing towards their organisation's electricity bill, actual energy cost savings might not be known in most cases.

Some (18% to a great extent and 54% to some extent; mean= 3.7) have audited the power efficiency of their systems and technologies. Nevertheless, such audits might not always be associated with retiring energy inefficient systems (r=0.52).

Although 77% of the organisations are concerned about their environmental footprint, only a few (7% to a great extent) developed IT-enabled capability to monitor their enterprise's footprint. As carbon emission reporting and trading regulations become enforceable, enterprises might be forced to implement such projects.

Figure 16: Maturity of Green IT Operation Practice



Despite Forrester's (2008) prediction of the "Dawn of Green IT Services", which is estimated to be a USD 4.8 billion industry in 2013, 61% of respondents have not engaged consulting services providers to help their Green IT policies and practices and only 5% have done so to a great extent. It is not clear whether this is due to the unavailability of such services or due to the lack of demand for it. Nevertheless large organisations tend to seek such services more than those in the small and medium size category. There is significant difference in some of the operational practices among countries. While Australian organisations tend to audit the energy efficiency of systems (mean= 4.4) and analyse IT's energy bill separately (mean=3.5), US organisations are leading in retiring energy inefficient systems (mean=4.3).

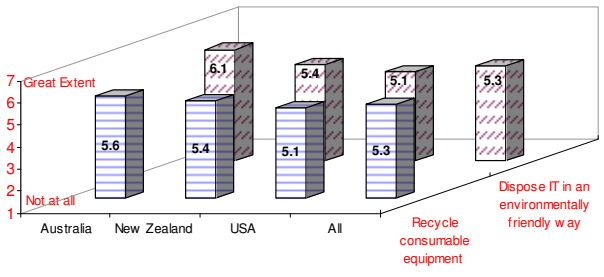
In Australia, the most common operational practice is to operate existing systems in an energy efficient manner (mean=4.8; 15% to a great extent and 72% to some extent), in US to retire energy inefficient systems (mean=4.3; 24% to a great extent and 62% to some extent) and in New Zealand to enforce PC power management (mean=4.4; 14% to a great extent and 71% to some extent).

There is a strong association between the IT size (as measured by the number of servers) and the maturity of Green IT operational practices.

Green IT End-of-IT-Life Management Practice

Of all the Green IT practices, recycling and other environmentally friendly disposal of IT are the most widely accepted practices. More than 90% of respondents in the three countries surveyed are either to a great (55%) or some (44%) extent recycle and dispose IT in an eco-friendly way. This correlates significantly with both the e-waste management concerns(r=0.63) and policy development maturity (r=0.72).

Figure 17: E-waste Management Practice



9. THE MATURITY OF GREEN IT- TECHNOLOGIES

Green IT is more than soft eco-friendly practices and includes hard technologies that can improve the energy efficiency of data centre and end-user focused IT (storage, servers, and network) infrastructure (GITI) and the network critical physical infrastructure (GNCPI) (lighting, cooling and power delivery). In addition to energy efficiency, the adoption of these clean technologies can reduce IT induced Greenhouse gas emissions. There are two types of energy consumption reduction- *temporary and structural consumption avoidance (*Rasmussen, 2006). While temporary avoidance refers to optimization of energy utilisation without reducing the installed power base, structural avoidance results in reduction in installed power capacity. The adoption of a number of GITI and GNCPI technologies, related to the two categories, was assessed (Figure 18, 19, 20).

Green IT Infrastructure Technologies

In terms of GITI, server consolidation and virtualisation (mean=5.4) is the most widely adopted technology with more than 90% of surveyed organisations having done so either to a great extent (56%) or to some extent (36%). 77%, 64% and 47% of US, New Zealand and Australian organisations respectively have virtualised and consolidated their servers to a great extent.

Other data centre focused technologies such as rightsizing IT equipment, storage tiering, storage virtualisation and data de-duplication are also getting increasing acceptance with more than 70% of respondents having implemented these technologies to some extent.

End user focused technologies such as desktop virtualisation and print optimisation are not as widely diffused as data centre focused technologies. Forty one percent of respondents have not implemented information systems and tools that remotely monitor end user IT and power it down when not in use.

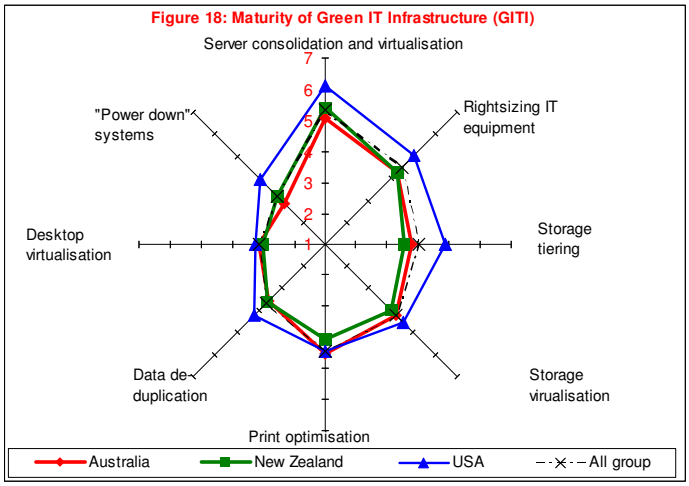


Figure 18: Maturity of Green IT Infrastructure (GITI)

US is the clear leader in Greening the IT infrastructure. The difference between US and Australian respondents is particularly significant in server virtualisation, storage tiering, rightsizing IT equipment and "power down systems".

There are no significant variations in the adoption of GITI across the different industries. Expectedly, organisations with larger server farms have moved aggressively in many of the GITI technologies.

Green Network Critical Physical Infrastructure (NCPI) Technologies

Greening the NCPI refers to improving the efficiency and reducing the energy consumption of cooling, power delivery and lighting of data centres. The diffusion of 11 technologies related to these three areas was assessed.

Overall, there is very low level of implementation of state of the art NCPI technologies. This survey shows that US organisations and especially those with larger server farms are leading in almost all of the data centre site infrastructure best practices.

Three out of four respondents have taken some initiatives in data centre airflow management. One would have expected installing energy-saving lights to have wider acceptance as such a practice doesn't require high investment and technical sophistication. However, only less than one third have fully installed such lights in their data centres.

Figure 19: Maturity of Green Data Centre Physical Infrastructure (NCPI)

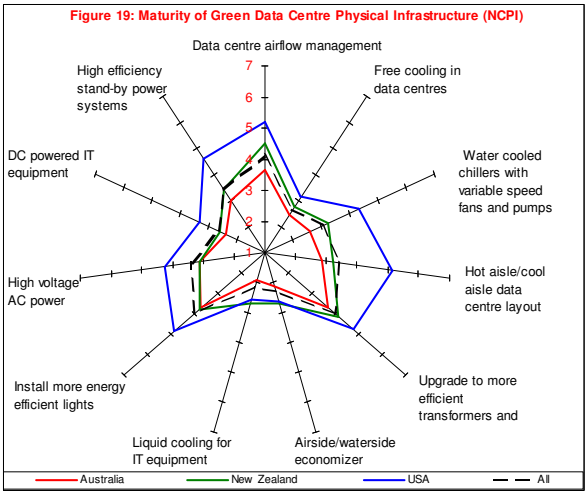
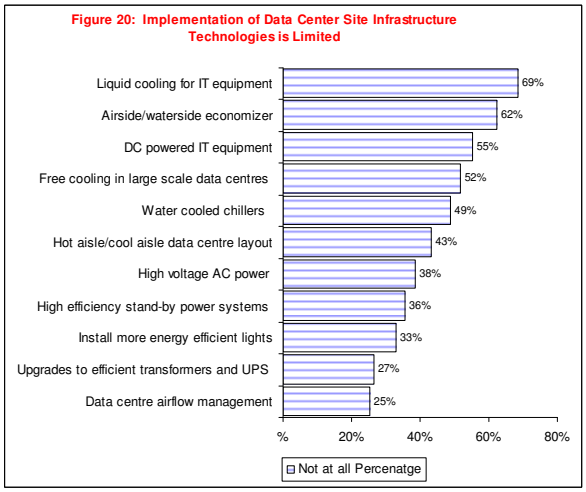


Figure 20: Implementation of Data Center Site Infrastructure Technologies is Limited



10. GREEN IT GOVERNANCE

Governance refers to the management infrastructure to implement Green IT. It is the operating model that defines the administration of Green IT initiatives to understand impacts, prioritise actions and manage an enterprise's responses. Roles, responsibilities, accountability and control for Green IT initiatives need to be clearly established.

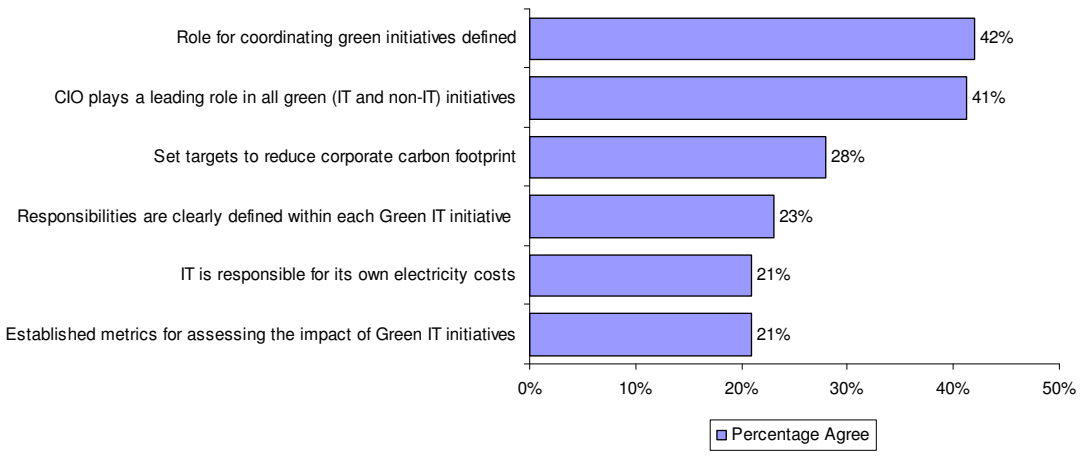
The findings (Figure 21) indicate that in less than half of the cases the role for coordinating Green initiatives is defined and CIOs are taking a leading role in all Green (IT and non IT initiatives). However, responsibilities within each Green IT initiatives are not well defined in more than 75% of organisations.

As nearly 80% of surveyed organisations' IT departments are not yet responsible for their own electricity costs and there are no clear metrics for assessing the impact of Green IT initiatives in the majority of organisations(79%), executives might not know the returns from implementing Green IT.

Less than 30% of organisations have set CO_2 targets to reduce their enterprises' overall environmental foot print. This might change as governments are enforcing carbon caps and carbon trading regimes. For example, Australia is expecting to implement such a scheme in 2012.

The only significant governance difference across the three countries is in terms of IT departments' footing their own electricity bill, which is required in 44% of US respondents compared to in 29% of New Zealand and 12% of Australian organisations.

Figure 21: Administrative Structure to Support Green IT is Just Beginning to Emerge
Regarding your organisation experience, to what extent do you agree with the following?



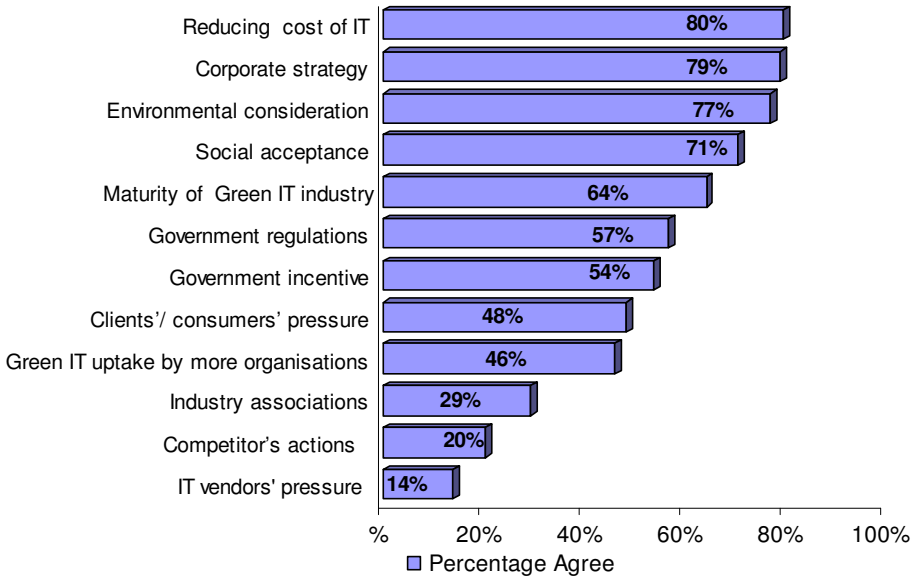
11. DRIVERS AND INHIBITORS OF GREEN IT

Organizational motivations for Greening IT can include an economic expectation of enhancing efficiency, a regulatory response of ensuring compliance and a normative objective of attaining legitimacy. The tension between the regulatory and ethical pressure on the one hand and the business case for top-line revenue and bottom-line costs on the other hand can influence the pace of Green IT.

The majority of respondents (figure 22) say that the main motivations for Greening IT are business strategies that emphasize not only environmental consideration but also cost savings. This implies that as corporate IT budgets continue to shrink, IT managers may turn to Green IT only if Green solutions are affordable and yield tangible benefits.

Figure 22: Corporate Stratgey that Emphasises Cost Reduction and Environemntal Sustainability Top the Motivations for Green IT

The main reasons for pursuing Green IT are



71% of respondents are pursuing legitimacy within the wider social context as concerned entities of global and local communities for Greening IT. The maturity of the IT industry in providing Green IT products and services appeared as one of the top five motivators.

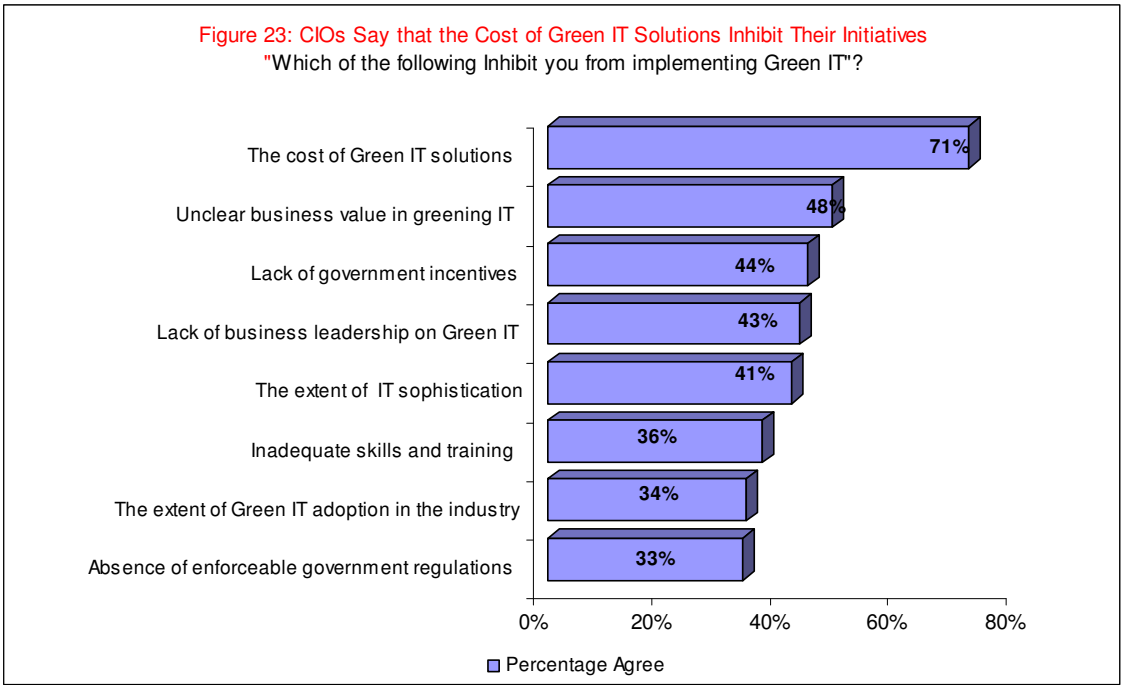
Despite most consulting firms featuring Green IT as one of the top considerations for IT management in 2009, market forces such as competitors', IT vendors' and client's pressure have not so far emerged as motivating Greening IT uptake. Most of the existing Green regulations and legislations are non-binding. As a result, a significant number do not yet see government regulations or incentives as driving their Green IT strategy.

There are no significant differences among the three countries in the importance and ranking of Green IT drivers. In addition, excepting competitors' action, the drivers appear to be more or les the same across the different industries. However, respondents from the education sector tended to perceive the importance of competitors' action in driving their Green IT significantly higher than others.

For respondents with large number of servers, government regulations, government incentives, own strategy and environmental considerations play significant role in shaping their action.

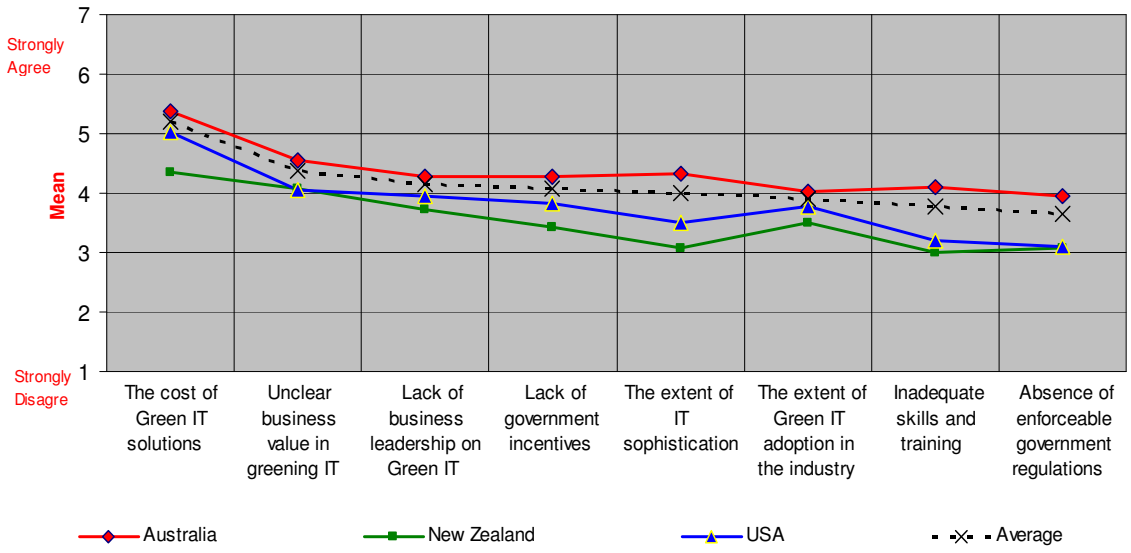
In terms of the inhibitors (Figure 23) the cost of Green IT solutions tops the list followed by unclear business value. Nevertheless, the cost perception does not appear as a major inhibitor for those organisations that have budgeted for Greening IT and allocated other resources. Absence of enforceable government regulations is the least of all the inhibitors. This implies that in the short to medium term, factors internal rather than external to an organisation might significantly influence Green IT adoption.

Figure 23: CIOs Say that the Cost of Green IT Solutions Inhibit Their Initiatives
"Which of the following Inhibit you from implementing Green IT"?



There are differences in the perception of Green IT inhibitors among the three countries (Figure 24). Australian organisations consistently ranked the inhibitors higher than both US and New Zealand. The difference is significant in terms of cost (40% agreeing compared to 29% in New Zealand and 20% in US) , extent of IT sophistication (48% agreeing compared to 29% in New Zealand and 27% in US) and lack of skill and training (44% compared to 21% in New Zealand and 20% in US).

Figure 24: Australian Organisations Perceive More Inhibitors of Greening IT
"Which of the *the following will inhibt you from Greening your IT?"*



12. SUMMARY

This study identified the *Reach and Richness* of Green IT and explored the relevance, motivators and inhibitors of Greening IT. Overall, both the Reach and Richness of Green IT among the surveyed organisations can be considered at the early stage of maturity. In terms of Reach, although there are indications of Green IT implementations in all the three areas, end-of-IT life management is the most widely adopted aspect of Green IT. The result further indicates that disposing IT in an environmentally friendly manner is the most relevant aspect of Green IT for the majority of the respondents. It is not therefore very surprising that there is a relatively deeper practice and policy in the end-of-IT-life management aspect of Green IT. On the other hand, Green IT sourcing is the least adopted.

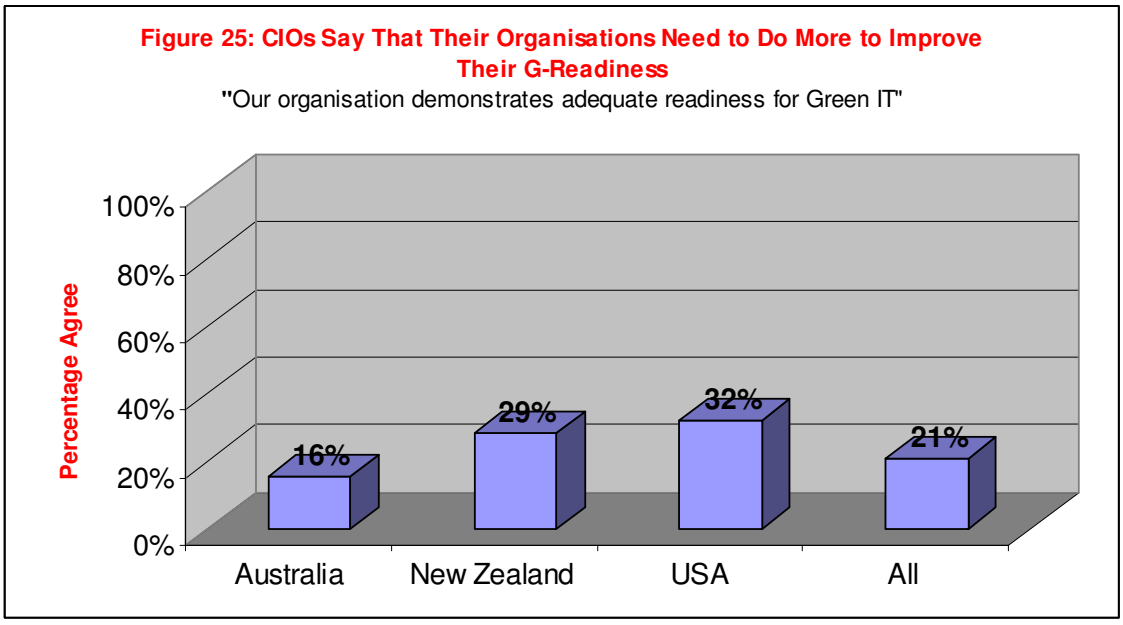
In terms of Richness, of all the items used to assess Green IT, server virtualisation and consolidation has the widest uptake with 56% of the respondents having implemented such a technology to a great extent and another 36% to some extent. In contrast, liquid cooling for IT equipment experiences has the least uptake with 69% of respondents not implementing such technology at all.

Most respondents view cost reduction as the main driver of Green IT on the one hand and cost of Green IT solutions and unclear business value as primary inhibitors on the other hand. It appears then that organisations might continue to Green-wash their Green IT strategy through recycling initiatives. Nevertheless, even this practice does not seem to have been thought in all cases at the time of IT sourcing as only 25% of organisations always prefer vendors that offer end-of-life take-back option. Further, a significant proportion of businesses do not consider the Green track record of their IT suppliers which shows a lack of a "cradle-to-cradle' approach to Green IT.

The findings suggest that current drivers of Green IT adoption have more to do with eco-efficiency and effectiveness and less with regulatory compliance. This perhaps explains why server virtualisation and consolidation tops the list of current adoption of Green IT technologies. This implies that as corporate IT budget continues to shrink, IT managers may turn to Green IT only if Green solutions are affordable and yield tangible and near term cost savings. Many believe server virtualisation to produce quick–win cost reduction. Thus, this preliminary result implies that business will consider costs in light of competitive, market and economic opportunities of becoming Green. Biased

In conclusion, most CIO's believe that their organisations are far from demonstrating a capability to Green IT(Figure 25).

Figure 25: CIOs Say That Their Organisations Need to Do More to Improve Their G-Readiness



Finally, the study has a limitation due to the small sample size. The findings can only be considered at best preliminary and require further data before any generalisation can be attempted. There is also a need for empirically testing the content and construct validity of the four dimensions of Green IT and developing and testing either an antecedent or causal model of Green IT adoption. This paper provides a foundation upon which other studies might build their framework.

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