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Understanding e-Waste Management in Developing Countries: *Building Sustainability in the Indian ICT Sector*

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Abstract

Management of e-waste is a growing problem for developing countries; one that may undermine the sustainability of ICT use if not addressed. In this paper, we focus on a somewhat under-emphasised group that contributes significantly to developing country e-waste: local organisational consumers of ICT. Although thought to create the majority of e-waste, the factors shaping the e-waste decisions of this group are not well understood.

This paper therefore builds a model of e-waste strategies and e-waste strategy determinants from the environmental management literature. It applies this model to a key e-waste producer – the ICT services sector in India – drawing qualitative fieldwork-based case studies from a mix of very large and small/medium firms.

While the former have been proactive in their e-waste strategy, the SMEs are characterised as indifferent to e-waste; a divergence explained by the very different strengths of determining factors to which they are subject. In turn, those factors relate to the size of these ICT consumers and the nature of value chains into which they are placed. Understanding these determinants can help us plan better e-waste interventions; a point illustrated through critique of recently-introduced legislation.

A. Introduction

Use of ICTs in developing countries has grown significantly since the start of the 21st century (ITU 2012), driven on by encouraging evidence and literature that associates ICTs with various aspects of economic and social development (UNCTAD 2011). Alongside these positive associations, however, have been growing concerns about the sustainability of development models that increasingly incorporate ICTs (Ali & Bailur 2007). Such concerns have included the economic (e.g. about inequality: Flynn-Dapaah & Rashid 2010) and political (e.g. about e-autocracy/e-oppression: Albrini 2008) but typically focus on environmental impacts associated with ICTs (GISWatch 2010). Such impacts can occur during the manufacture and use of ICTs but have been especially prominent in relation to end-of-life disposal.

This falls within the domain of "e-waste": electrical and electronic equipment that has ceased to be of value to its owners. ICT is a growing component within overall e-waste due to the rapid growth rates in ICT consumption, combined with falling average usage lifespan for digital technology (Chatterjee & Kumar 2009). Traditionally associated with the global North, locally-produced e-waste is an increasing problem for developing countries with, for example, more than 800,000 tonnes of e-waste being created annually in India (FE 2012). e-Waste is an opportunity for developing countries since valuable items can be recycled from it: glass, copper, nickel, chromium, silver, etc. But it is also a threat either if not recycled or if not recycled properly both from volume of landfill and toxicity of cadmium, mercury, lead and dioxins (Robinson 2009). At present, threats seem to outweigh opportunities. Again taking India, it is estimated that only 5% of e-waste is recycled, and that which is recycled is handled almost entirely by informal sector operators working in hazardous, polluted conditions (ELCINA 2009).

There has been relatively little work to date on e-waste in developing countries and such work as there is has often focused on the international trade in e-waste (e.g. Nnorom & Osibanjo 2008, Shinkuma & Managi 2010). But, as noted, given high double-digit annual growth rates in ICT consumption in most developing countries, local e-waste requires greater investigation. Within the literature on e-waste, the focus has tended to be on legislators, producers or recyclers (Subramanian et al 2012) but we wish to shift attention to the role of ICT consumers since it is they who determine when ICTs become e-waste, and it is they who determine what happens to that e-waste. In particular, we wish to focus on 'bulk consumers': organisational users of ICTs who generate the majority of e-waste (Agarwal et al 2003).

Given so little is known about the role of these organisations in e-waste, the research presented here looks at two foundational questions: what are the strategies for e-waste management within these organisations, and what are the factors which determine those strategies. Given the importance of ICTs within its national development strategies, we decided to study these issues in India, and selected the ICT service sector since this is estimated to contribute about 30% of all e-waste in the country (Chawla 2008).

We begin by reviewing literature in order to develop models of e-waste management practice and its factoral determinants, before explaining the specific methodology for this research. After presenting the findings from our field research, we end with discussion and conclusions.

B. Literature Review

The literature on e-waste in developing countries has to date been relatively limited. It has tended to focus on three main issues: the extent and effects of e-waste (e.g. Frazzoli et al 2010, Chung 2012), the international trade in e-waste (e.g. Shinkuma & Managi 2010), and legislation on e-waste (e.g. Akenji et al 2011). There has been little work on the practices and determinants of e-waste management, and we therefore have to develop our own models of these, drawing from the wider literature on environmental management which itself focuses largely on the global North.

Environmental practices are commonly understood as operating at the level of the organisation, and understood in terms of strategy. Models of environmental strategy offered in the literature analyse the strategies of different organisations into a set of categories along a continuum. One of the first of these, from Steger (1993), identified the strategies firms adopt in response to the environmental risks and opportunities they face, running from indifference and defensive strategy through offensive to innovative strategy. Roome (1992) developed a five-category model of strategies in relation to organisations' reaction to external legislation: non-compliance, compliance, compliance-plus, environmental excellence, and leading edge. Azzone and Bertelè (1994) explored the impact of context to expose five strategic responses which ran from stable through reactive and anticipative to proactive and creative.

Given the differences between these models; their derivation from the experiences of industrialised country firms; and their lack of specific reference to e-waste, we decided it would not be possible *a priori* to develop a detailed model of e-waste management strategy. Instead, we identified four generic strategic approaches which might be of relevance to field findings, drawing from the models discussed and others (e.g. Ghobadian et al 1995):

- Indifferent: the organisation does not adopt any strategic position in relation to e-waste.
- Reactive: the organisation adopts the minimum e-waste strategy necessary to react to its context.
- Proactive: the organisation pushes its e-waste strategy ahead of the basic reactive minimum.
- Innovative: the organisation sees e-waste as an opportunity and adopts an innovative strategy in order to address that opportunity.

But what might be the determinants of these different strategies: what causes one organisation to choose one path and another organisation to choose a different path? Again, there is no literature that offers specific guidance on e-waste management determinants and we again had to look to the literature on environmental management, drawn largely from the experiences of manufacturing firms in industrialised countries, in order to construct an initial model.

From this literature (e.g. Ghobadian et al 1998, Hoffman 2000, Benito & Benito 2006) we can see that a mix of factors external and internal to the organisation can be associated with determination of environmental strategy. From these, we draw out those factors which appear most repeatedly.

Key external determinants identified were:

- Government regulation: in particular the threat of fines and other costs (both financial and not directly financial) associated with non-compliance with environmental regulation (Cordano 1993, Ghobadian et al 1995), plus evidence that compliance can be a source of competitive advantage (Nehrt 1998).
- Peer pressure: especially where there is some form of sectoral association, peers are found to exert a normative influence on the strategic environmental behaviour of organisations in the same sector (Bansal & Roth 2000, Lynes & Andrachuk 2008).
- Client requirements: commercial organisations are significantly oriented to the requirements of their clients. Where these include requirements for particular environmental standards or actions, these can be a strong strategic influence (Delmas & Montiel 2007, Sarkis et al 2010).
- Corporate reputation/brand image: these intangible assets have high value for an organisation because of their role in both investor and client decision-making (Fombrun 1996) and they influence environmental strategy because environmental actions are seen to directly correlate to image and reputation (Miles & Covin 2000).

Key internal determinants identified were:

- Financial impact: financial implications are seen as a powerful shaper of organisational strategic decisions generally (Ghani et al 2010), and of environmental decision-making specifically (Stead & Stead 1995).
- Organisational culture: understood as the complex of values, beliefs, assumptions and symbols which define the way a firm conducts its business (Barney 1986), organisational culture necessarily impacts all decisions and actions, including those associated with environmental strategy (Howard-Grenville et al 2008, Lynes & Andrachuk 2008).
- Organisational leadership: organisational leaders are found to have an important influence on the environmental strategies their firms adopt (Egri & Herman 2000, Prakash 2001). We can see this as intimately intertwined with cultural factors since an organisation's leaders shape its culture, and that culture shapes selection or emergence of those leaders; this being found both generally (Pettigrew 1979) and in relation to environmental matters (Fernandez et al 2003).

To reiterate, these are factors drawn largely from the broad environmental management experiences of manufacturing firms in the global North; there being no model for e-waste strategies for organisations in developing countries. But we can draw them together to create the formative model shown in Figure 1.

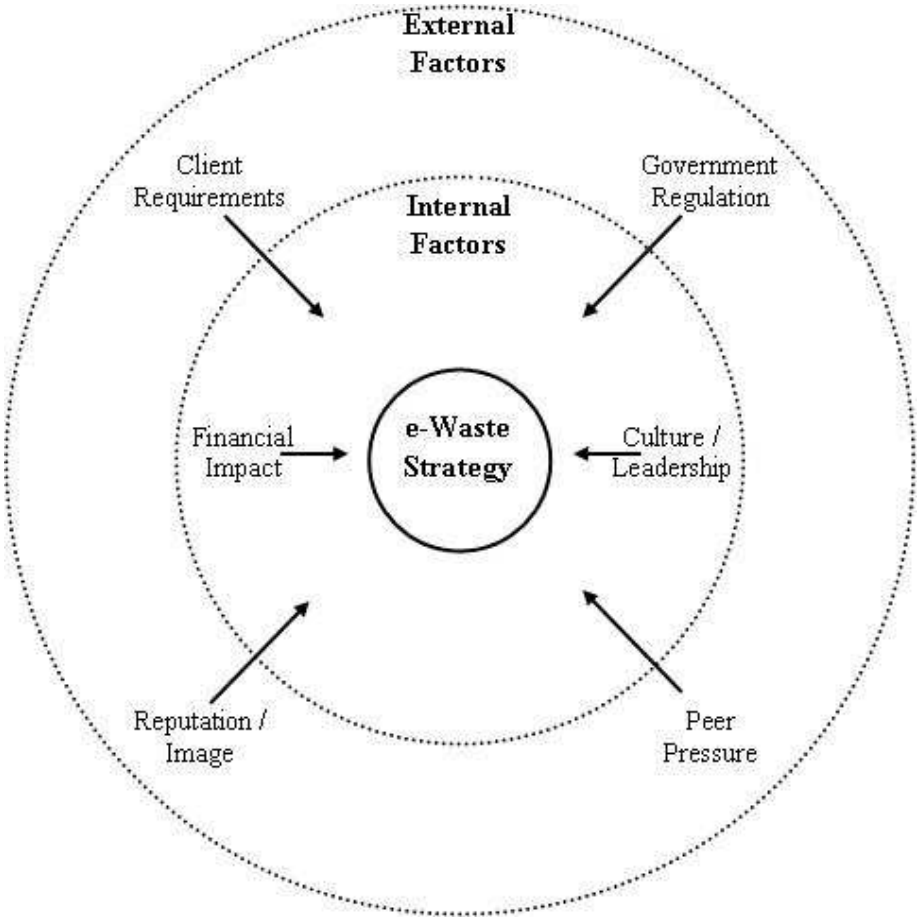

Figure 1. Conceptual Model of e-Waste Strategy Determinants

Our literature review has therefore produced two models of potential value to understanding e-waste management in developing countries: the continuum of e-waste strategies, and the circular model of factoral determinants of e-waste strategy. Our main research, then, was to instantiate these initial models via investigation of real-world practice.[1]

[1] This represents the finalised model used in the main fieldwork, described next. Space limitations prevent a full discussion of minor revision to the model based on pilot fieldwork which led to removal of one factor identified from the literature – NGO pressure – since this was not identified as present for any respondents; and incorporation of a second factor – employee demand – into the culture/leadership category since this was how any such demands were always said to be mediated.

C. Methodology

In order to investigate the continuum of e-waste strategies and the model of determinants, a qualitative research design was adopted since this has been shown appropriate to the research of social phenomena, of which e-waste strategy is one, and combining exploratory and explanatory elements (Taylor & Bogdan 1984, Durrheim 2008). Given the instrumental interest in real-life factors and their relationships within context, it was decided to investigate multiple organisation cases within the frame of a specific industrial sector (Stake 2005).

We focused on India. Use of ICT in India is growing fast – Internet usage by 31% per year; mobile phone subscriptions by 40% per year (ITU 2012) – and this has led to equally strong growth in overall e-waste; estimated to have grown from 147,000 tons in 2005 to around 800,000 tons in 2012; a rate many times faster than traditional waste (FE 2012). Of this, as noted above, only 5% is recycled, largely – at an environmental and health cost – by the informal sector (GTZ-MAIT 2007, Roche 2010).

Bulk consumers of ICT – organisations utilising multiple units of ICT equipment (as opposed to individual consumers) – are major contributors to e-waste in developing countries (UNEP 2007, GISWatch 2010). We therefore selected a sector – the ICT sector – in which very large volumes of ICT waste are generated (as already indicated, making up about 30% of all India's e-waste), in which there is a variety of different organisational types, and which serves both export and domestic markets. Specifically, we chose ICT service organisations which are members of NASSCOM, India's National Association of Software and Service Companies, which accounts for around 95% of ICT sector turnover in the country.

Since firm size is directly correlated with volume of e-waste generation, since size has been indicated to affect environmental management[2] and since the Indian ICT sector is strongly stratified by size, we decided to use size as a means of differentiating our sample. During 2011, we surveyed practice in five very large organisations (VLOs) from the pool of seven with global ICT services operations which employ more than 40,000 staff; and ten small and medium enterprises (SMEs) randomly-selected from the roughly 500 NASSCOM members which employ less than 1,000 staff and which serve a mix of domestic and overseas clients[3].

With qualitative research, triangulation is recommended as a means to strengthen research validity and reliability (Saunders et al 2012). This was addressed in two ways (Denzin 1978). First, by triangulation of perspective: for each organisation, we sought to approach two interviewees for a semi-structured interview; staff at both a senior and a more middle management position with responsibility for or knowledge

[2] Resource/capacity issues – including organisational size, level of general environmental knowledge, and availability of recycling facilities – were identified in this research as enablers (as opposed to determinants) of e-waste strategy implementation but, given space limitations, enablers are not discussed here.

[3] The VLOs are all globally-known Indian software / IT services / business process outsourcing firms; the SMEs similarly operated in one or more of those three market segments.

of e-waste practice within the organisation. For the very large organisations, this led to further recommendations for interview, with a total of 18 interviews being conducted in the five organisations. For most SMEs, only one relevant role could be identified, with 12 interviews conducted in the ten organisations. In addition, 36 further interviews were conducted with other stakeholders who were participants or had interests in the ICT lifecycle: ICT producers (7 interviews), recyclers (6), regulators (5) and industry association representatives (4) plus international and non-government organisations (7), dealers (3), and informal sector actors (4).

Second, by methodological triangulation. Semi-structured interviews were conducted as indicated, each lasting for an average of one hour. Interview content was developed from the literature review, covering e-waste strategies, determinants and actions within the case organisations. Interview design was based around structure laying technique (Flick 2009) using the simplified approach of presenting back at the end of the interview a graphical summary of key elements. Document analysis was undertaken on a variety of 'grey literature' items: organisational annual reports, sustainability reports, internal strategy and practice documents and presentations; plus government policies, news clippings, and reports from industry associations, NGOs, and others. Informal observation was also undertaken during tours of organisational offices, facilities, and e-waste storage and handling areas.

Data analysis was undertaken via the process outlined by Miles and Huberman (1994). Primary interpretation of interview data was fed back to interview respondents to check the validity of the interpretation with the source. In parallel, data was reduced by transcription and coding of the various data sources. In line with recommended practice, the codes were descriptive in nature and were iteratively developed from the foundation of the pre-formed, literature-derived categorisations of e-waste strategies, determinants and actions. Code validation was undertaken within the author group through scrutiny and discussion of the code categorisation and interpretation of interview transcript samples. Data was displayed via presentation on a spreadsheet matrix to enable cross-source triangulation. Data was then analysed through a qualitative classification system based on triangulated source frequency. Determinants were classified as strong if manifest in more than 60% of data sources (interviews, documents, observations); moderate for 30-60% of sources; weak if appearing in less than 30% of sources; and absent if not appearing in any data sources.

D. Findings

D1. e-Waste Strategies

At the time of fieldwork, there was no direct regulatory requirement on the very large ICT consumer organisations. However, they had initiated formal e-waste management procedures since, on average, 2006. These procedures were the identified responsibility of specific staff members and were well defined according to

quality standards, falling under overall green ICT policies as part of environmental management systems. Procedures stretched outside the organisations. Most e-waste was routed to one of the 23 formal e-waste recyclers established in India which most VLOs had audited to ensure the standards of e-waste handling. Remaining ICT was donated to secondary users such as local schools, and the VLOs were putting in place systems to track return of those donations back into the in-house e-waste handling stream. When organisations adopt such good environmental practices, with awareness and participation of groups including top management that lead to strategic engagement, and in the absence of regulatory requirements; they fall into the *proactive* e-waste strategy category.

The SME ICT services organisations had no formal policies or strategies that encompassed e-waste; nor did they have a wider green ICT policy or environmental management system. There was no systematic mechanism for e-waste disposal. SMEs tried to prolong the life of their ICT as long as possible but after that point equipment would sometimes be returned to a dealer when new equipment was bought; some SMEs were seen just piling old equipment in any available space on their premises; others sold obsolete equipment to scrap dealers if approached. There were no interactions with formal e-waste recyclers. For the majority of SMEs, e-waste was not an issue that had made its way onto the management agenda because they felt they had more pressing concerns to deal with; they can therefore be classed as having an *indifferent* strategic approach to e-waste.

D2. e-Waste Strategy Determinants

Why should these very different strategic approaches to e-waste management arise? Drawing on the field data shaped by the framework shown in Figure 1, we can seek to understand these differences in terms of the previously-identified determinants.

Government regulation was not present specifically in relation to e-waste, and all but the largest ICT firms were exempted from oversight by state-level Pollution Control Boards (PCBs). The government had issued rules on the handling of hazardous waste since the 1980s, with a 2003 amendment indicating coverage of e-waste. However, the remit was waste created during production of electronic equipment, not post-consumption waste. Guidelines issued in 2008 by the Ministry of Environment and Forests were broader but seen as inadequate, leading major ICT producers, international donors and others to initiate a consultation process that led specific e-Waste (Management & Handling) Rules to be drafted in 2010, legislated in 2011, and implemented from 2012 (i.e. after the fieldwork period). Based on principles of extended producer responsibility, these acknowledged the role of bulk and individual consumers in the creation of e-waste.

The very large ICT firms had to file annual environmental compliance reports to PCBs, and both documents and interviewees reflected on the importance of regulatory compliance. They had therefore been following hazardous waste rules when handling e-waste since the mid-2000s. All were well aware of the forthcoming e-waste-specific legislation and had ensured that they were already not just

compliant, but more than compliant; for example in their audit of recycling partners. In contrast, SMEs regarded regulations in the abstract as important but on the specifics of e-waste, they were not aware of either existing rules and guidelines or forthcoming legislation. Being exempt from any environmental oversight, these issues were simply not 'on their radar'.

Peer pressure was tangible within VLO interviews. Managers had participated in environmental fora of NASSCOM and through these were aware of e-waste practice in their peers. Environmental awards by industry associations were a particular motivator, seen as a means of benchmarking good practice and also gaining recognition. As a result, practices were learned and copied; as one Sustainability Director made clear: "If someone is doing then we say, why can't we also do this?". One signal of these isomorphic pressures was relative synchronicity: the firms all started using formal recyclers and certified environmental management systems around 2006, and in 2008 three began producing a Corporate Sustainability Report using Global Reporting Initiative standards, with the other two in process of doing the same at the time of fieldwork.

Although they are NASSCOM members, the SMEs did not participate in environmental discussions but, instead, in SME fora. Interviewees indicated that these shared information on a variety of ICT services practices but did not discuss 'green issues'.

Client requirements were a significant mechanism by which pressure to deal effectively with e-waste was transmitted to the very large ICT firms. The majority of their clients were US and European (especially British). 94% of publicly-traded companies in those countries insert 'green' clauses into their outsourcing negotiations and contracts (Brown 2008), and environmental performance plays a growing role in selection of ICT outsourcing vendors (Dataquest 2009). This was reflected in the VLOs' experiences with their clients, with interviewees sharing examples of environmental audit questionnaires used by clients (especially those from Europe; much less so with US clients). e-Waste was not often an explicit part of this but, due to the other determining factors, the ICT firms bundled it into their responses since e-waste was seen as an integral part of their environmental response and management systems. They also foresaw that e-waste would become an ever-more explicit part of negotiations and wanted to ensure compliance in advance of this in order to avoid any shortcoming that might lead to a loss of business.

SMEs' were equally client-sensitive, but their clients – mainly from the domestic market and, if overseas, typically smaller US and Asian firms – were not environmentally-demanding. As one Director put it: "Outsourcing of work happens for cost-relative purposes. … In this scenario, they [*clients*] do not attach weightage to environmental prospects". They had thus not experienced client pressures around e-waste.

Reputation and brand image can be very much related to the other three factors. For the very large firms, it was recognised as reflecting the perceptions of external stakeholders including government, peers, and existing and potential clients. As an intangible asset it was linked to the corporate bottom line, and had many feeder components including e-waste management. As one Director stated, "[*X company*] has built an image for itself for quality and good practices … we take up sustainable practices to maintain that, and e-waste is a part of this".

For the VLOs, these things matter because their size makes them highly visible to external stakeholders, and yet those stakeholders have only indirect relationships - mediated by image and reputation – with the organisation and its systems and processes. The opposite was true of SMEs – they are largely invisible to government, the mass media and their general client base, and they tend to work through direct relationships: "we sell our services through one-to-one interaction with customers", as one Director noted. The result is that brand was not an active concept for SME managers, and reputation related to word-of-mouth about delivery of ICT services, not to internal systems such as e-waste handling.

Financial impact was interpreted by interviewees to relate to the direct finances of e-waste management. The very large firms were aware of costs such as e-waste storage and they used a tendering system to dispose of defunct ICT via formal recyclers. But as huge, highly-profitable firms these costs were of minor significance compared to other determinants: "financial factors are not important for us for e-waste disposal", as one Facilities Head stated.

The SMEs marched to a different drum because their profitability was lower and cashflow tighter. They were imbued with a philosophy that 'every penny counts', and it was this above all which was seen to shape their views on e-waste. They were all concerned to maximise ICT lifespan, minimise management time associated with end-of-life equipment, and maximise income from disposal, which was achieved either through dealer-return and negotiated discounts, or through obtaining the highest-possible price for disposal to local scrap dealers.

Finally, *corporate culture and leadership* differed between the two sets of firms. Very large firms incorporate features of the ICT sector which make it different from traditional Indian industrial sectors: more flexible and informal working relations, a very young workforce, globalised working, and high levels of staff turnover (Upadhya & Vasavi 2006, Mishra 2011). One result is culture and leadership that is much more reflective of the views of employees; and those views are increasingly 'green': "We have these youngsters in recent years that are more aware than earlier generations. … They want us to be environmentally-responsible and want us to do these things [*manage e-waste*]", said one Sustainability Director. There is then a need – to help ensure staff loyalty and to assist with recruitment – for this to be reflected in practice, in leadership statements and in the reputation of the firm with these internal stakeholders. It was not possible to probe the validity of commitments which appeared in various Chairman's visions and Annual Reports, but interviewees

did appear to take a genuine pride in the VLOs' broad environmental strategies and specific recycling of ICT.

There was a more hierarchic style in SMEs that was less concerned with employee views, and the focus of leadership and culture that they largely shaped was staying in business. Sustainability issues – either per se or instrumentally in helping support that business agenda – were not identified as components of organisational culture or leadership guidance. As one SME Director stated, "Unless you bring it as a statutory requirement, none of the so-called leadership will pay attention to this".

D3. Linking Strategies and Determinants

Analysing the field data and strength of determinants on the basis of the categorisation described under 'Methodology', we produce the summary radar diagrams shown in Figures 2 and 3.

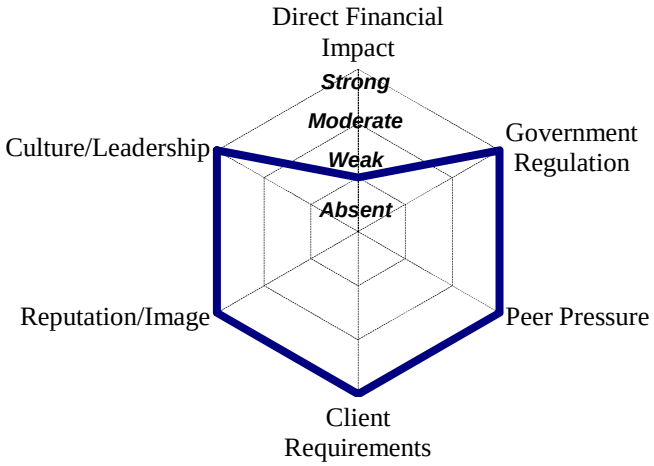

Figure 2. e-Waste Strategy Determinants in VLOs (Proactive e-Waste Strategy)

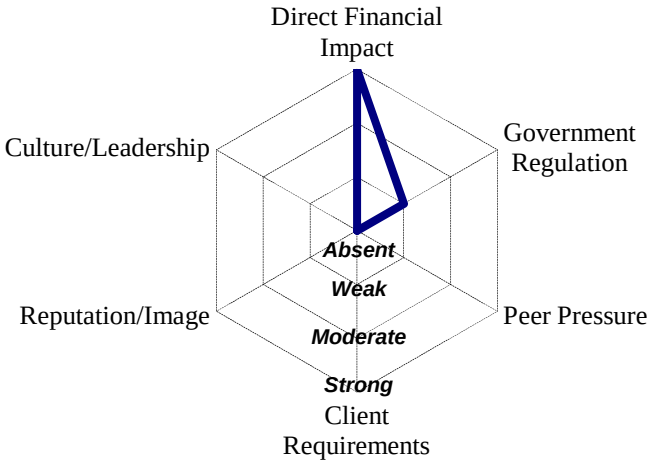

Figure 3. e-Waste Strategy Determinants in SMEs (Indifferent e-Waste Strategy)

For all six factors, there was a clear sense that they were important in shaping decisions about e-waste strategy: in other words, all of these were determinants[4]. But, the actual strength of the determinants in pushing the organisations towards more active strategies, showed two quite different patterns. For the very large firms, there was a strong set of driving forces, which had led them to a proactive e-waste strategy. By contrast, for SMEs, almost all the determinants contained no driving force, leading them to have an indifferent e-waste strategy.

E. Discussion and Conclusions

It is possible – field data did not permit a determination – that there is a socio-ethical foundation to the e-waste actions of the very large firms: that CEOs and senior management teams have a genuine environmental concern and a genuine vision for sustainable operations. But there is a far-stronger sense that all types of ICT service firms share a common core foundation: their financial bottom line. However, their differing contexts, including differing value chains, and different size lead them to significantly different interpretations of that bottom line and, hence, to differing e-waste strategies.

For the SMEs, e-waste is a peripheral nuisance; something on which to spend minimum effort in exchange for as much of a financial payment as can be extracted from their current connections to dealers in either ICT or scrap. Lacking any perceived contextual pressures, SME managers vest in e-waste no wider business or social or environmental ramifications.

VLO managers see – because they are forced to see – e-waste within a much bigger picture. e-Waste connects to profitability only marginally in the direct (minor) sense perceived in SMEs but rather in an indirect sense as it affects core profit determinants: the requirements of new and potential clients, corporate reputation, regulatory requirements, employee satisfaction. The VLOs are continuously made aware of this connection: not just by clients but by their peer group and their own staff. And they therefore see a two-way relationship. These factors determine e-waste strategy because e-waste strategy can affect these factors which, in turn, can affect profits. This fits the broader evidence that environmental practices can affect the corporate bottom line (e.g. Hillary 2004, Aragon-Correa & Rubio-Lopez 2007).

So e-waste is not a peripheral issue for the very large firms: it ‘expands’ in terms of both scope and time horizons. As just described, it scopes out to touch many aspects and stakeholders of their business. VLO management also has the capacity to think about the future direction of economic and socio-political curves; curves which SME managers are barely aware of since they are so focused on short-term survival: a contrast between horizon-scanning vs. ‘nose to the grindstone’. In doing so, VLO

[4] Respondents were specifically asked about other factors which were determining their e-waste strategies but no other such factors were identified.

managers understand the value of getting ahead of those curves: knowing requirements for stronger e-waste management are coming they lose nothing by implementing them now, and they might just gain some reputational and perhaps contractual advantage.

If we look to the deeper factors which shape the e-waste strategic determinants, size has already been identified and is known to be correlated to more proactive environmental strategies (Alvarez Gil et al 2001). Larger firms have the capacities for such strategies but their greater visibility to distant stakeholders and hence the greater importance of reputation and image impel greater proactivity. The external factors have a greater salience for these firms because of the nature of their value chains.

Although not differentiated by the categorisation adopted, there was a clear sense from all respondents that client requirements were the *primus inter pares* of the determinant factors; being mentioned with greater frequency than any other but also being most directly linked to e-waste actions. Hence, the nature of the organisational value chains shaped their sustainability actions. For both larger and smaller firms, these are client-driven value chains in which sub-contractor behaviour is significantly shaped by the interests of the client (Gereffi 1999). For the SMEs, those interests have focused largely on cost of the ICT services delivered (though also requiring delivery beyond a quality threshold).

The VLOs operate within global value chains in which cost and quality are important for clients but so, too – at least for some – are environmental standards. Global value chains are sometimes criticised for offshoring environmental costs (e.g. pollution) from the global North to the global South (Levinson 2010). But, in this case, the global value chains have been responsible for offshoring environmental values and practices. Due to the highly competitive nature of ICT service supply, and the relatively low barriers to changing outsourcer, the power in these chains lies with the clients and their requirements. These have pushed the very large firms to adopt sustainable strategies – for example around e-waste – in advance of local regulatory pressures. Indeed, they have led these firms to themselves pressurise the Indian government to 'get its act together' around the issue of e-waste legislation.

Isomorphic institutional forces are readily transmitted through global value chains (Guler et al. 2002) and have thus led Indian firms to adopt the same types of e-waste strategies, standards and practices found in firms within Europe and the US. The same applies to the government legislation that was being formulated during the fieldwork period, and subsequently put into law. This follows the typical approach in the global North based around extended producer responsibility (EPR), by which ICT producers are responsible for taking back end-of-life ICT. Yet this mismatches the current status of both e-waste determinants and practice: a problem found in some other developing countries (Kojima et al 2009).

As described above, none of these bulk consumers has an e-waste relationship with ICT producers: other channels are used. Not only would the current legislation

require a new mechanism to be put into place, but existing relationships and mechanisms would have to be ruptured; something which is never easy. All bulk consumers currently receive a financial payment of some kind for their e-waste; yet EPR assumes the producer makes no payment. The strength of this determinant varied between bulk consumers, but it was always present and this makes it even more difficult for the legislated route for e-waste disposal to come into practice. What will most likely be required is an arrangement whereby recyclers (who currently run at less than full capacity) are formally recognised as proxies for the producers, and continue to provide payments for e-waste collected.

Legislation also falls down on the matter of ICT SMEs. SMEs form around 80% of all ICT companies in India and contribute in total around 30% of output (Upadhyay 2007)[5]. On that basis, it is likely that they contribute around 30% of ICT bulk consumer e-waste, yet they are exempt from the new e-waste legislation. Our analysis of determinants suggests that, were SMEs to be brought into the purview of regulation, it would have an effect on their e-waste strategy. A stronger pressure point is client requirements, and it is possible that civil society pressure on clients and directly on SMEs could exert an effect to move them from their current indifference. There are also collective, government bodies – the Software Technology Parks of India, and state Micro, Small and Medium Enterprise boards – which register SMEs. They could help take responsibility for raising e-waste awareness among SME senior managers, but also for collective recycling: pooling across firms in order to reap economies of scale and enable end-of-life ICT from smaller firms to connect into formal recycling mechanisms.

In conclusion, we have focused on an aspect of ICT-related sustainability of growing importance in developing countries: the handling of e-waste. As part of exploratory research, we developed and instantiated two models of relevance to e-waste in developing countries: a continuum of e-waste management strategies, and a model of determinants of those strategies. These models have helped us to understand not just what key producers of e-waste are doing about this issue, but also why. These insights are essential for the planning of effective e-waste interventions in developing countries; a point illustrated by our ability to critique current Indian e-waste legislation on the basis of the new knowledge created here.

Given their application to just one sector in one country, and given the exploratory and qualitative nature of the work undertaken, we must be guarded in claims about the wider validity of our two models, though their derivation from the wider literature certainly suggests they could be more generally applicable. We hope that future work will test application of the models in other sectors: for other bulk ICT consumers (such as organisations in government, education, healthcare, finance, retail, etc) and informal sector enterprises, for other technologies (e.g. mobile ICT), and in other developing countries.

[5] Defining SME as <500 employees. Although our definition was <1000 employees, eight of the ten SMEs surveyed fall into the <500 staff category.

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