

E-Inventory for Proactive e-Waste Management

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ABSTRACT

The Government of India is going ahead with e-Governance implementation vigorously. Research & development proposals are being sought from premier academic institutions too. India is one of the fastest growing Information Technology (IT) markets in the world and also the fastest growing personal computer market in the Asia-Pacific region. Almost half of IT hardware in India is consumed by the government in the operations as well as in various projects and programs. Inevitably, rapidly increasing computer waste is becoming the most significant of electronic waste (e-waste) being generated in India. This work proposes and reasons out the need of a national level inventory maintenance system in a uniform format; also reasoning out several benefits for the government including monitoring of the e-waste scenario.

Categories and Subject Descriptors

H.4 [Information Systems]: Types of Systems – *Decision Support*; J.1 [Computer Applications]: Administrative Data Processing – *Government, Law*

General Terms

Management, Legal Aspects, Standardization

Keywords

e-Waste; e-Inventory, Bulk Consumer

1. INTRODUCTION

1.1 Facts and Figures

India is a union of states and has a quasi federal government. There is a Central/Union government and various state governments. There are various ministries functioning under these governments; and functioning under these ministries are offices of various departments, directorates etc. Besides these, there are the universities, judicial courts/tribunals, public sector undertakings (PSUs) etc.

At present, purchases of IT hardware in the offices of these departments/organizations are made in a centralised manner within the department or by way of budget allocation to different

offices in the department down the hierarchy.

As per the estimates of Ministry of IT & Communications, the demand for IT hardware & electronics in India is expected to touch \$400 billion by 2020. With the current rate of domestic production, a very significant \$320 billion worth of IT Hardware & electronics will be imported to cater to this need by 2020. Almost 85% of the entire industry has import content and more than 50% of industry's consumption is government-centric [3].

The main sources of e-waste in India are the government, public and private (industrial) sectors, which account for almost 70 per cent of total waste generation [1]. The 2012 report of the ministry of environment and forests (MoEF) says that Indian e-waste output has jumped 8 times in the last seven years [4]. A report of the United Nations predicts that by 2020, e-waste from old computers would increase by 500 per cent on 2007 levels in India [1].

1.2 Issues to Be Considered

Apart from the e-waste generated indigenously, the country is also facing the problem of illegal imports of e-waste. In a recent initiative taken by the government, the e-waste (Management and Handling) Rules, 2011 have been made effective since 1st May, 2012. The e-waste rules shall apply to manufacturers and consumers of electronic goods and also the collection centres and recyclers of e-waste. As per the e-waste rules, the responsibility of handing over the discarded goods to authorised collection centres lies with the consumer and the bulk consumer [2]. Ensuring that the citizens i.e. individual consumers carry out this responsibility is likely to take some time because the task of spreading awareness across a socially diverse India would not be easy. In case of bulk consumers, an appropriate information system would be a great aid in achieving compliance of the said rules.

Since the government sector is the biggest bulk consumer of IT hardware (as brought out in section 1.1), implementation of the e-waste rules in the government sector would address the major part of the e-waste concern.

1.2.1 Purchase optimisation

The purchases of IT hardware in a typical government office could be either local, i.e. from the funds allotted from higher formation or be centralised, in which case the higher formation makes the purchase and allots the hardware to the office. There is also a possibility that the part of the purchases could be local and part, centralised. For justifying the need/requirement of IT hardware while seeking sanction of grants/funds for the purchases, assessing the optimum requirement becomes a major challenge due to many factors like

a. *insufficient technical knowledge* about IT hardware;

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ICEGOV2013, October 22-25, 2013, Seoul, Korea

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- b. *idle/unutilised hardware*. There is usually a mismatch in the speed with which hardware is purchased and the speed with which the corresponding software is developed and put to use. This results into a situation where hardware ages out without being optimally used and hence a substantial life of the hardware is wasted. This in turn results into generation of unnecessary e-waste.
- c. *specs above requirement*. In case of unnecessarily higher specifications, a significant part of the purchased IT hardware goes unused.

1.2.2 Data reliability

At the time of disposal, the asset has to be first checked for recyclability, for which it would be given away by the bulk consumer to an authorised recycler through a collection centre. A track has to be kept mapping the details of the authorised recycler and the collection centre directly to the initial purchase details of the asset. In the absence of such a mapping in prevalent practice, the usage life of the asset is not easily ascertained. After years of use, it becomes difficult to find the old manual records pertaining to the initial purchases.

The major constraints in applying available methodologies for e-waste assessment are related to availability, reliability, amount and range and completeness of the data [5]. As per the inventory assessment manual under the United Nations Environment Programme 2007, there is no reliable database of the total amount of e-waste in India [5].

2. NEED OF THE HOUR

The United Nations Environment Programme, 2007 has detailed the e-waste trade chain in the inventory assessment manual [5]. As per the e-waste trade value chain, “asset consumption” is the feeder module to “e-waste generation” module [5]. The same is represented in figure 1 below.

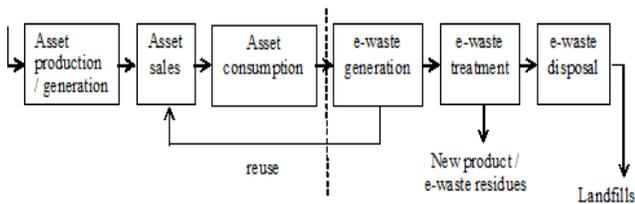


Figure 1.

Hence, if the data of e-waste generation is to be reliable, the consumption data has to be reliable and complete. As more than 50% of the consumption is government-centric, the first initiative has to be towards a uniform format for asset stock data across all government offices, PSUs, banks etc.

2.1 Usage Analysis

The scenario of such large number of offices using so much IT hardware demands certain proactive measures to be taken for proper management of the inevitable e-waste explosion. The main proactive measure is to moderate the purchases and the budget allocation so as to bring these to an optimum level. To achieve this, a proper analysis of budget allotted, assets purchased and usage during past years is to be done vis-à-vis the long term and short term needs. Higher formations could make major purchase policy decisions by analysis of the usage of the purchased hardware by lower formations, parallel formations and even other

departments. The analysis can be a comparative study item-wise, category-wise, state-wise, region-wise, department-wise or year-wise etc. The human intelligence involved in this analysis at all levels of the government would greatly benefit from an aid in the form of a software which would use the relevant data pertaining to all the offices across the country. To make such data available and accessible from anywhere anytime, the basic need is an online inventory maintenance system at consumption level, referred to as “e-inventory” henceforth.

2.2 Centralised Information

The details of each and every purchased asset in an office needs to be maintained in e-inventory. The details when an asset changes hands, for example shifted from one office to another, would also need to be maintained in e-inventory. At the time of disposal, the details of the asset to be disposed have to be mapped with the details of the authorised collection centre and the authorised recycler. Though purchase and disposal could be decentralised, information should be centralised in e-inventory with access restrictions as per administrative requirements. Thus, the need of the hour is the maintenance of e-inventory in a uniform format for all departments/PSUs/universities, banks etc. The first step for that has to be creation of a master index database of three entities – offices, category of assets in the market and authorised recyclers.

2.2.1 Indexing of offices

For the centralised information, the first requirement is the proper indexing, in a master database, of all the ministries, departments and offices till the lowest level of hierarchy. Every office, irrespective of its level in the hierarchy, say bank branch, head office etc., would need to have its own unique identifier.

2.2.2 Indexing of category of assets

The next requirement is the proper indexing, in a second master database, of the categories and sub-categories of all possible kinds of electronic hardware or assets to be purchased and used in the offices.

2.2.3 Indexing of authorised recyclers

The authorised recyclers and also the collection centres of e-waste, designated as per the e-waste rules, would have to be indexed in a third master database.

From all the above, the key objectives can summarised as below :

- a. Maintenance of reliable asset consumption data
- b. Indexing of offices, assets and recyclers
- c. User interface modules for usage analysis and budgeting.

3. THE DATA MAINTENANCE SYSTEM

The proposal highlights the essential elements to be maintained in e-inventory without going into details of database design.

3.1 Essential Elements

The below shown figure 2 represents a broad view of the proposed system involving the databases to be constantly maintained.

- a. DB-3 would be the main regular transactional database, containing the asset consumption data
- b. DB-1, DB-2.1, DB-2.2, DB-4.1 and DB-4.2 would be the index databases ;
- c. X, Y and Z would indicate the user interface modules.

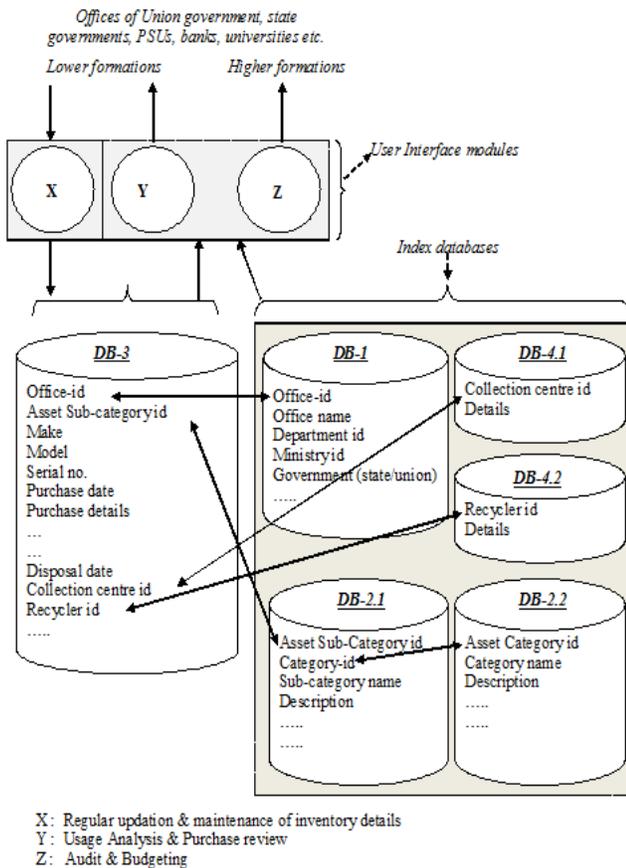


Figure 2.

3.2 DB-1

The objective of DB-1 would be to identify each office at the lowest user level by the office-id, and further associate the office with the other master details i.e. its department, ministry etc. The office-id would link DB-1 with the main transactional database DB-3.

Examples of data in DB-1 would be :

- i. Office-id-1, Department of Revenue, Ministry of Finance, Union government ,
- ii. Office-id-2, Department of D1, Ministry of M1 , government of state-S1 ,

The maintenance of DB-1 database would ensure that all offices and departments all over the country can be connected by their respective office-ids to DB3, which would be the main database containing micro-level details of the electronic hardware purchased by the offices.

3.3 DB-2.1 and DB-2.2

These databases would categorise different kinds of electronic hardware or assets. This would enable generation of information for any macro or micro level as per the category or sub-category. The primary key to DB-2.2 would be the major category-id of the asset, say for example, Hard disk drives or HDD. The primary key to DB-2.1 would be the minor category-id of the category of the electronic hardware, say for example, external HDD or internal HDD. DB-2.1 would be connected to DB-3 by the minor category-id. Forseeing the future needs of macro level analysis,

the categorization can be escalated to more levels, as per administrative requirements, during the implementation phase of e-inventory.

3.4 DB-3

DB-3 would be the main database for user access for regular transactions. This would be having the lowest level entry which will include serial number or a bar code or any combination which would be the unique identification of the asset. So, from the typical example above, i.e. external HDD and internal HDD as two minor categories within a major category named HDD, a particular external HDD allotted to an office will have its unique serial number in DB-3 with the office-id.

3.4.1 Purchases

At the time of purchase of the asset, the unique identity of the asset including the make, model etc. would be entered in DB-3. The minor category would be available from the connecting key to DB-2.1. There can be other details in DB-3 like the date of purchase, vendor name etc.

Purchase details relevant to e-waste assessment can also be recorded in DB-3. Examples would be

- the 'green' rating of the vendor/Original equipment manufacturer
- the vendor's offerings/services related to e-waste management considering that some vendors offer e-waste management services.

Such details in DB-3 would help at the time of disposal and also in selecting vendors during future purchases.

3.4.2 Disposal

At the time of disposal of an asset, the entry in DB-3 containing serial number would be mapped to the authorised collection centre identifier. The entry would be further updated with the authorised recycler identifier.

3.5 DB-4.1 and DB-4.2

DB-4.1 would be the index database of the authorised collection centres and DB-4.2, that of the authorised recyclers. At the time of disposal of the hardware, the DB-3 records would be mapped to the respective identifiers of the authorised collection centre and the authorised recycler to whom the hardware is handed over for recycling.

4. ADVANTAGES AND USES

Strengthened by uniformity in data maintenance, there are several advantages and uses of the proposed e-inventory system.

4.1 Advantages

- a. The proposed system e-inventory would necessitate indexing of all offices of the government including PSUs, banks, universities etc. in all states of India. This index database can be used for other e-governance applications too.
- b. Transparency of data would be a major advantage. Access restrictions can always be an administrative measure. Data regarding purchases can be even made openly accessible, wherever possible, reducing the need of public queries under The Right to Information Act.
- c. Many government departments have started using online e-procurement portal for inviting tenders. This will soon become a norm for government tendering process. The e-inventory system can potentially take pivot data from e-

procurement system and raise alerts in case the corresponding asset(s) is not added into e-inventory in due course. Many market vendors have their own ERP (Enterprise Resource Planning) systems for supply chain management of orders/supplies. Upon confirmation of purchase orders/bids, the e-inventory system can use the trigger from e-procurement system and can interface with such ERP systems for inventory details.

- d. Reports and stock taking would be available on-line, whether it be office level or department level or state level or national level. This can replace decentralised manual record keeping, thus saving many man hours.
- e. As much of the usage of IT hardware in India is government-centric, the centralised inventory would be a ready reference showing the market trend of IT hardware time to time.
- f. Aiding decision making and further policy making by governments, banks etc. regarding purchases and usage of hardware.

4.2 Uses

The various uses at each level are as below:

4.2.1 For all formations

If the pricing/accounting details and vendor details are also included in e-inventory, the same can be used for :

- tracing out any kind of disparity in purchases;
- better market survey and easy identification of potential vendors/product sources etc.; and
- easy verification of price offered (Usually, there is a clause in government notices inviting tenders that price offered should not be more than what has been offered to another government department in last one year or so).

4.2.2 For lower formations

Lower formations seeking grant/funds for their purchases can make more reasoned justifications. Manual record keeping can be replaced by e-inventory as an online stock register.

4.2.3 For higher formations

Higher formations can make periodical reviews of the purchases and consequently, do better audit and budgeting using all the data online. Aiding information would be available in e-inventory, examples of which are:

- buying patterns of the departments eg. are they buying close to the budget expiry date, hence increasing the chances of random / hurried (and hence wasteful) purchases?
- whether a department has purchased only computing hardware, without any equivalent UPS support, network, or any other support infrastructure.

4.2.4 For all stakeholders

The market cycle can be monitored very easily at any level for any category and consequently, the e-waste scenario can be monitored. The proposed system would be an aid in reducing the quantum of e-waste and environmental hazards thereof. It would also become a source of information for researchers analysing effectiveness of e-governance initiatives.

5. CONCLUSION

With the foreseeable mammoth piles of e-waste in the coming years, it is very necessary to be proactive and put a uniform inventory system, accessed and managed online, in place. The stake holders in e-inventory, i.e. the various offices/departments and the e-waste collection centres/recyclers shall participate directly or indirectly in making purchases to an optimum level and thus curbing e-waste eventually. The proposal is intended to reason out the idea and need of e-inventory at national level.

The government has already taken initiatives like e-waste rules [2] and the research paper[3], proving the intent to curb e-waste. The implementation of e-inventory as an aid to these recent initiatives is expected to evolve in due course. Further work is on for a prototype system.

6. SCOPE

- i. The proposal can be extended to the inclusion of corporate inventory too to contribute in monitoring of e-waste scenario.
- ii. The inventory system could be extended to all electronic and electrical assets other than IT infrastructure/hardware.
- iii. The proposed system would necessitate indexing of government-centric bulk consumers and authorised collection centres & recyclers of e-waste. The e-waste rules make it mandatory for these entities to maintain records and file annual returns [2]. This part of the database can be expanded so as to have the said returns and forms/records maintained online.

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