An Environmental Integrated Management System for Electronic Waste inside Enterprises

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Abstract

Increasing of the electronic waste all over the world is related to the rapid growing of information and communication technology. Electronic waste contains highly toxic substances and improper handling for this kind of waste will cause several impacts on human health and environment. Management of electronic waste is still in its initial phase in different developing countries.

Aim of the study: Absence of specific guideline and strategy about managing of electronic waste inside different enterprises leads to develop an evidence-based integrated environmental system for management of electronic waste by using an Evidence Based Practice (EBP) methodology. This integrated system covers all aspects related to the management of electronic waste

This system can be used as a guideline by the officials and responsible staff in different enterprises for managing of electronic waste in proper manner to safeguard the human health and environment from the negative impacts that generated from electronic waste.

Key words: E-waste, types of e-waste, evidence based practice and waste management.

نظام الإدارة البيئية المتكاملة للمخلفات الإلكترونية داخل المنشأت

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المستخلص

نظرا لما يشهده العالم من تطور في مجال تكنولوجيا الاتصالات و المعلومات فقد أدى ذلك إلي ظهور ما يعرف بالمخلفات الإلكترونية و تعد هذه المخلفات خطرة نظرا لما تحتويه في تركيبها من مواد خطرة و التي تسبب أضرار بالغة للأنسان و البيئة. تمثل الإدارة الغير سليمة لمثل هذا النوع من المخلفات تهديدا للصحة و البيئة ، من هذا المنطلق فإن وضع نظام إدارة متكامل للمخلفات الالكترونية أصبح ضرورة الأن ضمانا للحفاظ على البيئة و صحة الانسان.

إيمانا بأهمية وجود منظومة للأدارة المتكاملة للمخلفات الإلكترونية داخل المنشأت المختلفة فقد أعتمدت هذه الدراسة على تصميم نظام إسترشادي متكامل لتوضيح وشرح نهج الإدارة السليمة للمخلفات الإلكترونية مستندا على أدلة مرجعية من خلال قواعد البيانات العالمية و قد روعي عند تصميم النظام إختيار الأدلة التي تغطى كافة المتطلبات الخاصة بهذا النظام.

و يمكن الاسترشاد بهذا النظام لتطبيقة داخل المنشأت المختلفة لتحسين إدارة مثل هذا النوع من المخلفات و تقديم الدعم للمؤسسات و الأفراد لتحقيق الصحة و السلامة البيئية للأفراد و المجتمع .

Introduction

The electronic waste is commonly known as e-waste, waste electrical and electronic equipment (WEEE) or end of life (EOL) electronics which means waste that have finished their useful lives [1]. Generation of large quantities of e-waste annually leads to increases the attention on how e-waste is generated, handled and the effective ways to prevent its negative impacts to human health and environment.

Effect of e-waste on environment

In developing countries, the lack of suitable infrastructure and legislation related to this type of hazardous waste are the most important challenges to manage of electronic waste.

Disposing of this waste is occurred by burning it in open air or dumping into surface water bodies. Also, improper recycling practices are highly polluting. All these practices lead to contamination of air and migration of contaminants to the water bodies [2].

Effect of e-waste on human health

This waste contains toxic substances such as **lead** that damage nervous system, blood system, kidney and reproductive system in human, **cadmium** compounds bioaccumulate and damage kidney, liver and cause prostate cancer, **mercury** cause problems to various organs including brain and kidney. Potent pollutants such as **polychlorinated biphenyls** (PCBs) which known as neurotoxicants, **chlorofluorocarbons** (CFCs), **hydrochlorofluorocarbons** (HCFCs) and **brominated flame retardants** may damage reproductive system , liver, and kidney also act as the main reason for cancer [3].

Evidence based practice (EBP)

Evidence based practice (EBP) is a problem – solving approach to delivery e-waste management system that integrates the best evidence from studies within an efficient and acceptable manner [4]. This methodology is adopted to establish strategies to increase electronic waste management via a systematic review and critical appraisal of the published literature by applying sequential phases to design the best integrated management system for e-waste with completed criteria.

Electronic waste is becoming a major threat to the environment , it creates a need to realize the importance of managing e-waste and implementing a comprehensive policy on electronic waste management inside different enterprises that generate this type of waste.

Methodology

Evidence based practice (EBP):

The integrated management system for e-waste was developed according to process of evidence- based practice. Actually the criteria of the Scottish Intercollegiate Guidelines Network (SIGN) 2008 and the American Academy of Neurology 2004 for developing guidelines were adopted [5].

This methodology was adopted in this research via sequential phases:

Phase one: Stating search questions:

Fifteen search questions were constructed by using the PICO principle (P =population, I= indicators, C= comparison, O= outcome) [6].

1. What are the different categories and types of e-waste that generate from educational, industrial and healthcare enterprises?
2. What are the most effective regulation and legislative of e- waste management that should be applied by educational, industrial and healthcare enterprises?
3. What is the most effective structuring hierarchy of authorities for sustainable e-waste management process?
4. What are the responsibilities of responsible staff to monitor effectively the e-waste management policy inside enterprises?
5. What are the effective methods of capacity building about e- waste management for responsible staff members?
6. What are the most effective methods for internal communication inside educational, industrial and healthcare enterprises to ensure the cooperation between responsible staff members for proper management of e- waste?
7. What are the most effective methods for external communication between enterprise and competent authorities to exchange information and experiences on management of e-waste?
8. What are the most effective methods to minimize e-waste generation from source?
9. What are the most effective steps to segregate e-waste inside enterprises?
10. What are the most effective steps to collect e-waste regularly inside enterprises?
11. What are the main methods for labeling to prevent mixing of e-with other waste?
12. How to transport e-waste inside enterprises to prevent breaking of e-waste?
13. What is the most important characterization of storage room inside enterprises?
14. What are the most important steps to document e-waste management policy inside enterprises to evaluate the policy effectively?
15. What are the most effective methods to assess e-waste management policy periodically?

Phase two: Searching for the related evidence:

A literature search was undertaken to identify potentially relevant evidence to develop the intended evidence-based e-waste management system. A set of primary and secondary researches and evidence-based guidelines of waste management was reviewed. Review of the literature was conducted from electronic bibliographic database. The searched bibliographic database is illustrated in Box 1.

Searched bibliographic database

http://www.pubmed. gov	http://ovidsp.tx.ovid.com
Science direct: http://www.sciencedirect.com	Center for Review and Dissemination (CRD) at www.york.ac.uk/ins/crd/
Wily Blackwell: http://onlinelibrary.wiley.com/	http://search.ebscohost.com/
WHO: www.who.net	CDC: www.cdc.gov
Scottish Intercollegiate Guidelines Network at: http://www.sign.ac.uk/	Cochrane Library, Database of Systematic Reviews http://www3.interscience.wiley.com/cgi-bin/mrwhome/106568753/Hom
National Institute for Health and Clinical Excellence (NICE) at: www.nice.org.uk	National Electronic Library for Health at www.libararyies.nelh.nhs.uk/guidelinesfinder/
National Guideline Clearinghouse at www.guideline.gov	Sage at http://intl-online.sagepub.com
Joster at http://www.jstor.org/stable/41548607	¡Springer link
Emerald at http://dx.doi.org/10.1108/14676370910925226	ProQuest
EBASCO	

The numbers of obtained documents were 303 studies; studies that include management of e-waste outside the enterprises were excluded. These documents included systematic reviews of randomized trials, cohort studies, and cross sectional, case-control studies, expert opinion and guidelines management for managing of e-waste.

Phase three: Evaluation of evidence:

The retrieved studies were appraised by two members of the development group according to the Generic Appraisal Tool for Epidemiology (GATE, 2001)[7]. The GATE included two main steps to evaluate evidence, namely; study validity rating, and determination level of evidence.

First step: study validity rating

All primary studies and reviews addressing the relevant topic were appraised by using GATE checklist that was appropriate to the study design, and then were individually rated for internal validity using

Second step: determination level of evidence:

The study design is assigned by numerical prefix using the (GATE) system below then each study is assigned to a level of evidence

Phase four: Formulation of integrated management system for e-waste drafts:

A draft of the integrated management system for e-waste was formulated and redrafted three times before the final approved format.

Phase five: Stating the guideline' recommendations according to the Scottish Intercollegiate Guideline Network (SIGN) System (2008)[5].

Results and discussion

Integrated management system for e- waste that developed at the present study which composed of main nine sections:

1. Categorization of e- waste
2. Regulations and legislation related to e-waste
3. Structuring roles responsibilities and authorities
4. Training and awareness
5. Communication
6. E-waste minimization inside enterprises
7. Handling of e-waste inside enterprises
8. Documentation
9. Quality Improvement

1. Categorization of e- waste

Each enterprise should be classified their e-waste. This section describes the main categories of e-waste. Ten categories of electronic equipment were covered by WEEE Directive [8]. The main categories: large household appliances - small household appliances – information technology and telecommunications equipment - consumer equipment - lighting equipment - electrical and electronic tools (with the exception of large-scale stationary Industrial tools) - toys, leisure and sports equipment - medical devices (with the exception of all implanted and infected products - monitoring and control instruments - automatic dispensers (Recommendation number 1.1).

2. Regulations and legislation related to e-waste

Adherence to national regulations and legislative principle is important to implement this system effectively inside enterprises.

This section includes twelve items that explain the different articles that should be applied by each enterprise. On the basis of one guideline,[8] Egyptian environmental law 9/2009 and executive regulation,[9] and one experimental study[10] which described the most important articles of relevant regulations and legislative to mange e- waste in proper manner inside enterprises. These articles were about handling (collection, internal transportation, labeling, storage requirement and final disposing), waste minimization from source of generation, the presence of emergency plan, awareness program and occupational health issues (Recommendations number 2.2, 2.3, 2.4, 2.5, 2.6, 2.7 and 2.8).

On the basis of one guideline [8] it concluded that any management policy for waste should be documented. Also, keeping records is very important to be available to responsible

staff inside enterprises, public and environmental affairs authority for auditing and reviewing (Recommendations number 2.9, 2.10, 2.11, and 2.12).

3. Structuring roles responsibilities and authorities

This section includes eighteen items that explain the structuring of the responsible staff and determining their responsibilities.

The manger responsibilities are directing responsible staff, evaluating performance and taking corrective actions and decisions when necessary (Recommendations number 3.1.1, 3.1.2, 3.1.3 and 3.1.4)

Regarding to the responsibilities of **environmental manger** inside enterprises, the cooperation with the other member of the responsible staff to monitor and control the implementation of action plan. Also, he should determine source of e-waste generation and monitor the handling process (collection, segregation, storage and outside safe disposing) (Recommendations number 3.2.1, 3.2.2, 3.2.3, 3.2.4 and 3.2.5).

The training programs about e-waste management should be implemented by environmental manager. Also, it recommended that the environmental manger should be responsible for designing of the supportive sheets to assess and control e-waste generated from enterprise (Recommendations number 3.2.6, 3.2.7and 3.2.8).

Maintenance engineer should be one of the e-waste management team. The maintenance engineer responsible for examining, maintaining, preparing a report for any equipment. Also, he should play a role in minimizing e-waste by using parts from old equipments (Recommendations number 3.3.1, 3.3.2, 3.3.3 and 3.3.4).

On basis of one Guideline [8] it recommended that the **financial controller** will responsible for supplying the required items for e-waste management process inside enterprises. Also, he will control the regular collection of e-waste by certified agency. (Recommendations number 3.4.1 and 3.4.2).

4. Training and awareness

Training and awareness section includes five items that explain how to raise awareness of responsible staff members about e-waste management.

On the basis of three survey[11][12][13] and one experimental study[14] they concluded that the capacity building of the responsible staff will be enhanced by establishing of training programs. These will be realized by orientation of new staff, training, internal promotion, and participation in awards events, community engagement. Also, subsidies or incentives may be applied to best practices and reporting of achievements (Recommendations number 4.1, 4.2, 4.3, 4.4 and 4.5).

5. Communications

This section includes two main items that describe the internal and external communications. The internal communications means communication between managers and responsible staff inside enterprise. The external communications means

communication between enterprises and different competent authorities and organizations.

A. Internal communications

On the basis of one case study,[15] one review [16] and international standard ISO 14001. 2004(E)[17] they concluded that establishment of internal communication channels between the staff and the manger is very important issue. The methods of internal communication may include regular work group meetings, newsletters, bulletin boards and intranet sites. This communication will encourage each member in the staff to discuss, evaluate the already existing practices and suggest new practices (Recommendation number 5.1)

B. External communications

New knowledge will be acquired by establishing external communication channels. On the basis of one case study,[15] international standard ISO 14001. 2004(E)[17] and one review[18] they described that establishing external communication channels through different authorities and organizations will lead to coordinate, share, utilize, obtain, and evaluate information. Organizations should implement procedures for receiving, documenting and responding to relevant communications from interested parties. The methods for external communication may include annual reports, newsletters, websites and community meeting (Recommendation number 5.2)

6. E-waste minimization inside enterprises

E-waste minimization section includes five items which describe the waste minimization policy which considered as the top of waste management techniques.

For **eco-design**, on the basis of one review [19] which recommended that it is important to purchase equipments with specific characterizations. The equipments should be less bulky (size/mass), less heavy materials, foldable for storage and transport. Also they should be made from durable materials and saved energy. The components of the equipments should be replaced and dismantled easily to ensure extended product life (Recommendations number 6.1.1, 6.1.2 and 6.1.3).

For **reuse**, on the basis of two experimental studies, [20] [21] and one case study [22] they recommended that some components of old equipment should be used as spare parts. Also reusable equipment should be donated to nonprofits or schools (Recommendations number 6.2.1 and 6.2.2)

7. Handling of e-waste inside enterprises

Section of handling of e-waste includes thirty items which describe the proper handling of e-waste inside enterprises to prevent negative environmental impacts. The handling process includes segregation, collection, labeling, internal transportation and storage inside enterprises

For **segregation**, on the basis of one report [23] it recommended that it is important to divide the e-waste into their main groups to ensure easily separation (Recommendation number 7.1.1). On the basis of one case study [24] it concluded that special containers should be present for each type of e-waste (Recommendation number 7.1.2).

Proper training for appropriate segregation to responsible staff is very important. Also, regimentation and fining are necessary to implement proper handling (Recommendations number 7.1.3 and 7.1.4).

Regarding to **collection**, on the basis of Egyptian environmental law 9/2009 and executive regulation,[9] and one case study[24] they described that it is important to collect e-waste continuously from source of generation (Recommendations number 7.2.1).

On the basis of one Guideline,[8] one case study[24] and one handbook,[25] they emphasized that good quality storage units (special containers) with specific characterization should be present. The containers should be free of dents, corrosion, not leak, made of or lined with materials which will not react with the waste, with wheels for easy transportation and designed in proper shape to ensure for easily loading and unloading of waste (Recommendations number 7.2.2, 7.2.3 and 7.2.4).

On the basis of Egyptian environmental law 9/2009 and executive regulation,[9] one guideline,[8] experimental study [14] and one hand book,[25] they concluded that containers should be clean and wash regularly. Capacities of containers should be suitable. Also, special place should be present for these containers. Containers should be labeled with the name of the department and the date of collection (Recommendations number 7.2.5, 7.2.6, 7.2.7 and 7.2.8).

On the basis of one survey [12] and one case study [15] they recommended that proper training for appropriate collection practice to responsible staff is very important. Also, regimentation and fining are necessary to implement proper handling (Recommendations number 7.2.9 and 7.2.10).

Labeling should be paid attention. According to one handbook[25] and one Qualitative study[26] they concluded that laws and regulations emphasized the existence of a clearly label on the container which illustrates the accumulation start date and identifies the waste. The label should be illustrated the waste characterization and handling requirements. All handlers should know what the markings mean. All old markings/labels should be washed off or blacked out before reusing containers again (Recommendations number 7.3.1, 7.3.2, 7.3.3, 7.3.4, 7.3.5 and 7.3.6).

Regarding **internal transportation**, on the basis of one Guideline [8] it recommended that wheeled trolley should be used for internal collection. Also it can be lined with material to prevent breakdown of e-waste and compatible with the waste. Wheeled trolley should be designed in a proper shape to ensure easily loading and unloading of waste (Recommendations number 7.4.1, 7.4.2, 7.4.3 and 7.4.4).

According to different evidences, **storage** inside enterprises is crucial issue. On the basis of Egyptian environmental law 9/2009 and executive regulation,[9] and one case study[24] they recommended that the storage room should to be with impermeable surface and the provision of spillage collection facilities are available. Appropriate decanters, cleanser-

degreasers and water supply for cleaning and firefighting should be present (Recommendations number 7.5.1 and 7.5.2).

On the basis of one guideline [8] and Egyptian environmental law 9/2009 and executive regulation [9] they described that the storage room should have electrical power and be lighted for security at night (Recommendations number 7.5.3 and 7.5.4).

On the basis of one handbook [25] it recommended that the storage room should have access for loading, unloading and responding to emergency situations. The capacity of storage room depends on quantity, types and storage time. Finally proper locations of storage room should be away from other functional areas (Recommendations number 7.5.5, 7.5.6 and 7.5.7).

On the basis of one guideline, [8] Egyptian environmental law 9/2009 and executive regulation,[9] one survey[13] and one handbook[25] they recommended that only trained waste handlers should be allowed to enter these areas and the storage room have a restricted area sign. Also, the hazardous waste register should be present in storage room (Recommendations number 7.5.8, 7.5.9 and 7.5.10).

8. Documentation

Documentation section includes five items. On the basis of international standard ISO 14001 2004(E) [17] and one Qualitative study [26] they concluded that details of the documentation should be sufficient to describe the main elements of environmental management system and their interaction. Also, record should be legible and approved by authorized committee inside the enterprises (Recommendations number 8.1, 8.2, 8.3, 8.4, 8.5 and 8.6).

9. Quality improvement

Periodic evaluation of the waste management system inside enterprises should be enhanced to ensure its continuing suitability, adequacy and effectiveness.

Quality improvement section includes five items describe how to achieve the internal audit and management review. On basis of one review [16] and international standard ISO 14001, 2004(E) [17] they recommended that an integrated waste management plan should be present in accessible place with good information for reviewing, auditing and changing over time. E-waste management plan should be revisited and updated on a regular basis. Finally management review and internal audits should be documented to be used for decision-making (Recommendations numbers 9.1, 9.2, 9.3, 9.4 and 9.5.

Table 3.1: Evidence linked recommendations

Serial	Recommendation statements
1.	**Categorization of e-waste**
1.1	Classify e-waste
2.	**Regulations and legislative related to e-waste**
2.1	Include commitment to comply with national environmental legalization and regulations
2.2	Contracted with licensed facility to collect e-waste.
2.3	Clear definition of handling, labeling, storage requirement and final disposing of e-waste
2.4	State waste minimization regulations
2.5	Include emergency plan to deal with any unexpected accident during handling of e-waste
2.6	Include training plans and awareness program and training for all staff about e-waste management
2.7	Include occupational health issues
2.8	Clear definition and categorization of electrical and electronic waste qualitatively and quantitatively
2.9	Include commitment to continuous revision and improvement
2.10	Include clear procedures for implementation
2.11	Policies should be documented
2.12	Policies should be communicated and available to employees, public and environmental affairs authority
3.	**Structuring roles responsibilities and authorities**
3.1	**Manager of enterprises**
3.1.1	Development of team work of e-waste management system inside enterprises and determination of their responsibilities
3.1.2	Developing documented an action plan for team work of e-waste management
3.1.3	Determination of responsibilities for each member in the team work
3.1.4	Provision of financial resources and confidentiality to ensure the implementation of the plan as appropriate
3.2	**Manger of environmental responsible**
3.2.1	Monitor the implementation of the action plan of e-waste management
3.2.2	Determination with the team work all sources of e-waste generation
3.2.3	Monitoring the collection, segregation, storage and disposing of e-waste
3.2.4	Ensuring safe disposing of e-waste outside enterprises through contract with approved disposal facilities.
3.2.5	Ensuring the presence of special containers for e-waste with a specific labels
3.2.6	Designing a training and awareness plan about management of e-waste.for the member of responsible staff
3.2.7	Designing of data base about quantities and sort of e-waste generated from each department inside enterprises.
3.2.4	Designing sheet to receive e-waste from each department.

3.3	**Maintenance engineer**
3.3.1	Preparing plan to examine and maintain of all equipments.

Table 3.1: Evidence linked recommendations Continue..

Serial	Recommendation statements
3.3.2	Preparing reports about the status of equipments.
3.3.3	Notifying officials about the status of old equipments.
2.3.4	Participate in waste minimization strategy through using components of old equipment as spare parts.
3.4	**Financial Controller**
3.4.1	Contacting to environmental manger to confirm the continued funding of the required items of e-waste management.
3.4.2	Put a timetable for the collection of waste so as not to leave a long time in storage containers and follow up the commitment of contracted authorities to dispose waste out of the facility. (keeping e-waste manifest)
4.	**Training, Awareness and competence**
4.1	Identify training needs of employees
4.2	Establish training and raising awareness programs
4.3	Conduct conferences by experts about e-waste management
4.4	Develop posters illustrating algorithm of e-waste management
4.5	Evaluate periodically the effectiveness of training and education programs
5.	**Communications**
5.1	Establish internal communication channels among different authoritative levels and functions
5.2	Establish external communication channels and process including receiving, documenting and responding to external parties
6.	**E-waste minimization inside enterprises**
6.1	**Eco-design**
6.1.1	Use cleaner products with less toxic materials and with reduced number of components.
6.1.2	Purchase equipments with less bulky (size/mass), less heavy materials, and foldable for storage and transport
6.1.3	Purchase equipments made from durable materials, energy saving device, and dismantling
6.2	**Reuse**
6.2.1	Examine and maintain old equipments continuously
6.2.2	Reuse components of old equipment as spare parts
7.	**Handling of e-waste inside enterprises**
7.1	**Segregation**
7.1.1	Separate e-waste into main group (refrigeration equipments – other large household appliance - equipment containing CRTs - lighting equipments - other e-waste)
7.1.2	Select the proper containers for each type of e-waste
7.1.3	Training to everyone involved in the waste management process for appropriate segregation practices

| 7.1.4 | Regimentation and fining are necessary to implement proper procedures |

Table 3.1: Evidence linked recommendations Continue..

Serial	Recommendation statements
7.2	**Collection**
7.2.1	Collecting e-waste continuously from source of generation.
7.2.2	Ensuring the presence of good quality collection units for collecting e-waste (wheeled, covered, free of dents, corrosion, not leak , and made of or lined with materials which will not react with the waste)
7.2.3	Use Containers with proper shape to ensure easy to loading and unloading waste from these containers
7.2.4	Select containers with specific features for different types of e-waste (CRT Containing Devices (CCDs), Refrigeration devices (RDs) and lighting (linear and compact fluorescent tubes)
7.2.5	Cleaning and washing regularly
7.2.6	Use containers with suitable capacities
7.2.7	Label containers with the name of the department and the collection date
7.2.8	Training to everyone involved in the waste management process for appropriate collection practices
7.2.9	Regimentation and fining are necessary to implement proper procedures.
7.3	**Labeling**
6.3.1	Labeling the waste components in each storage container clearly
6.3.2	Marking all containers with word e-waste
6.3.3	Marking containers with the accumulation start date – the date you begin collecting waste.
6.3.4	Identifying the waste, including name, characteristics, and handling requirements.
6.3.5	Make sure all handlers know what the markings mean.
6.3.6	washing off or blacking out all old markings/labels before reusing containers
7.4	**Internal transportation**
6.4.1	using wheeled trolley for internal collection
6.4.2	select trolley lined with material to prevent breakdown of e-waste
6.4.3	Select trolley designed in proper shape to ensure easy loading and unloading of waste
6.4.4	Easy to be clean
7.5	**Storage inside enterprises**
7.5.1	Ensuring that the surface of storage room is impermeable and the provision of spillage collection facilities are available
7.5.2	Ensuring the availability of decanters and cleanser-degreasers with water supply for cleaning and firefighting
7.5.3	Ensuring the presence of electrical power, including power supply
7.5.4	Be lighted for security at night
7.5.5	Must have access for loading, unloading and responding to emergency situations
7.5.6	Ensuring that the capacity of storage site is suitable for quantity, types and storage time.
7.5.7	Ensuring that the location of temporary storage areas away from other functional areas
7.5..8	Ensuring that only trained waste handlers allowed to enter these areas.
7.5.9	Having a restricted area sign: a hazardous waste storage area.

Table 3.1: Evidence linked recommendations Continue..

Serial	Recommendation statements
7.5.10	Ensuring that the presence of record keeping and the e- waste register. (sheet 3)
8.	**Documentation**
8.1	E-waste Management policy, objectives and targets
8.2	Description of the main elements of the environmental management system and their interaction, and reference to related documents
8.3	Description of the main elements of the environmental management system and their interaction
8.4	Documents, including records, required by International Standard
8.5	Documents, including records, determined by the organization to be necessary to ensure the effective planning, operation and control of processes that relate to its significant environmental aspects.
8.6	Records should be legible and approved by authorized committee inside the enterprises
9	**Quality Improvement**
9.1	E-waste authorized committee should reviews the strategies, policies and regulations periodically
9.2	A program and procedures for periodic audits should be stated
9.3	Review and audits should be documented
9.4	Feedback and needs for change should be reported for each responsible staff member
9.5	Developing improvement plans of e-waste discipline in highlight of auditing and reviewing processes

The present integrated management system for e-waste demonstrates several strength points. Firstly, it describes the most important criteria to manage e-waste in different enterprises. Secondly, the stated recommendations are clearly and applicable to be applied. Finally, this management system could be easily implemented by responsible staff they are in need for such system.

The present integrated management system is based on different types of studies which are systematic review, case study, surveys, guidelines, handbooks and Egyptian environmental law 9/2009 and executive regulation.

The selected references about e-waste almost have the same criteria and process for a successful integrated management system development which include proper selection of the topic form of multidisciplinary group of work, developing search questions, comprehensively review of literature, rating of articles and summarizing finding.

Moreover, the successful integrated management system should include writing supported practice recommendations, reviewed and critically appraised by experts in this field. Finally, this system met the scope and purpose for managing of e-waste inside different enterprises.

Conclusion and recommendations

Conclusion

The integrated management system for e- waste is developed on the foundations of the evidence - based approach to provide an integrated framework in sequential process for managing of e-waste inside enterprises.

Recommendations

a. Awareness and training programs about management of e-waste should be conducted by experts.
b. Great events and initiatives about e-waste should be conducted (conferences – workshops – competitions) to encourage the participation of enterprises.
c. Assist enterprises by donating a fund to establish the management of e- waste.
d. Regular coordination and communication between enterprises and relevant governmental authorities should be present to exchange information and experiences about management of e-waste issue.
e. Submit the developed environmental integrated management system to the authorized organizations in Alexandria Governorate.

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