

# Study of e-Waste Management with Green ICT in Thai Higher Education Institutions

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**Abstract**—The purpose of this research study was to comprehend the e-Waste management with green ICT in Thai higher education institutions. The research procedure had three main steps: 1) to identify types of e-Waste in Thai higher education institutions, 2) to investigate the progress of Thailand's Information and Communication Technology Policy for 2011 – 2020 under the strategy section 7.2 for Thai academic institutions, and 3) to study of how the e-Waste is managed and handled in Thai higher education institutions.

The results of the study reveal that 1) e-Waste in institutions of Thai higher education is categorized into eight types: e-Waste came from IT and telecommunications equipment, Consumer equipment, Lighting equipment, Electrical and electronic tools, Large household appliances, Monitoring and control instruments, Small household appliances and Medical devices; 2) the progress of ICT 2020 or Smart Thailand 2020 was to clearly indicate that not all Thai higher education institutions were aware of the deployment of Thailand's Information and Communication Technology Policy for 2011 – 2020 under the strategic section of 7.2 including its purposes and implementation; and 3) the e-Waste management was done under the principle of ICT EcoDesign following the 4Rs.

**Index Terms**—E-waste, e-waste management, e-waste types, 4Rs, green ICT, higher education institutions.

## I. INTRODUCTION

Growing of economics and expanding of country and manufacture industry in recent years including the significant competition in the market which leads to continually develop of technologies rapidly. In order to need of new electronic products of consumers in the market, worse in quality and shorter life for many electric appliances would be happened as Electronic Waste or e-Waste.

## II. LITERATURE REVIEW

As standard WEEE Regulation 2006 of the united nations organization: UNEP (United Nations Environment Programme) and electronic waste management manual of Ministry of Natural Resources and Environment [1], [2] defined that the meaning of Electronic Waste - WEEE: Waste from Electrical and Electronic Equipments which are substandard working or expired or out of date of electric appliances could be divided by 10 types:

1) Large household appliances such as refrigerators, freezers,

washing machines and so on.

- 2) Small household appliances such as vacuum cleaners, electric irons, toasters, shavers and so on.
- 3) IT and telecommunications equipment such as personal computers, mainframe computers, laptops, scanners, faxes, telephones, mobiles and so on.
- 4) Consumer equipment such as radio, television, digital camera, video recorder, electric musical instrument and so on.
- 5) Lighting equipment such as Fluorescent lamps, sodium lamps and so on.
- 6) Electrical and electronic tools such as drills, electrical saws and so on.
- 7) Toys, leisure and sports equipment such as game boy, electronic toys and so on.
- 8) Medical devices (with the exception of all implanted and infected products).
- 9) Monitoring and control instruments such as smoke detectors, temperature controller and so on.
- 10) Automatic dispensers such as automatic soft drink machine and so on.

Caprice Lawless [3] of ISTE (International Society for Technology in Education) of United States of America conducted the research about the responsible of e-waste extermination management in institution summarized how to manage e-waste system in five Steps:

Step 1 Educate yourself about local, national, and international legislation; To study in localization laws, rules and regulations about e-waste management system in the country which is institution is located.

Step 2 Investigate recycling options from the companies that sell you equipment; Many manufacturers offer consumers a percentage off the purchase price of a new piece of equipment upon returning the old one to a retailer such as Best Buy. In addition, many electronics manufacturers are partnering with retailers such as FedEx Kinko's, Office Depot, Office Max, and Staples to collect used equipment for recycling.

Step 3 Learn about shredding and sorting and how to certify that recycling is happening; To study the correct instruction for separating electronic equipments' part and select educational e-waste.

Step 4 What others are doing; To determine the correct procedures for separating electronic equipments' part and select educational e-waste in institutions for preparing to recycle in next process.

Step 5 Put together your plan for responsible; e-waste management. After educating yourself and stakeholders about applicable e-waste legislation and researching local recycling opportunities, consider viable solutions for your organization. Keep in mind partnerships locally and

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internationally and involve the whole community in the solution.

The Ministry of Information and Communication Technology [4] determines Thailand's Information and Communication Technology Policy for 2011 – 2020 called 'ICT2020' for supporting the development of Information and Communication for more efficiency education in Thailand. By defining the detail of strategy planning number 7 about the development and adaptation of ICT for supporting economic progressive and environment companion for encouraging people to be aware of every Life Cycle Assessment (LCA) by determining strategy number 7.2 as shown in Fig. 1.

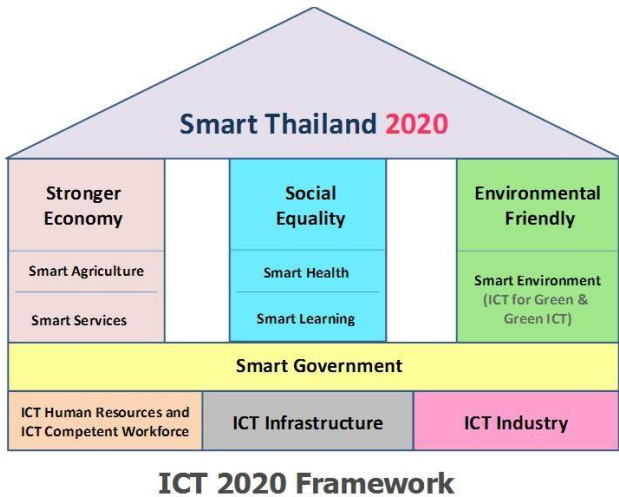


Fig. 1. Thailand information and communication technology (ICT) policy framework (2011-2020).

Strategy 7.2 ICT and Environment: the Green ICT. The main aim of the strategy is to make ICT an important driving force in green economic and social development. The strategic actions and measures concerning greening of ICT as well as greening by ICT are as follows: Promote environmental awareness at every step of ICT product life cycle by issuing design regulations for eco-design. Develop ICT products that have greater production potential, reduce costs and lower natural resource use at every step of the manufacturing process. Develop eco-label for ICT products manufactured in the country. Undertake public relations and build up awareness of the people about eco-labels before purchasing ICT products. At the same time, promote knowledge, understanding and awareness of ICT impacts on the environment. Set conditions for purchasing ICT goods and services by the public sector with due consideration to environmental sustainability. Also, encouraging producers and consumers for following the standard of ICT EcoDesign [5] as 4Rs in every ICT product's cycle; reducing use of resources and energies (Reduce), repeating (Reuse/Repeat), recycling (Recycle) and repairing (Repair) in all ICT equipments. For encouraging all of producers and consumers help to reduce use of natural resources and manufacturing pollution [6], [7].

### III. RESEARCH AIMS AND OBJECTIVES

#### A. Majority Objectives

- 1) To study e-Waste management system in institutions of Thai higher education by Information Technology and Communication for green environment.

#### B. Minority Objectives

- 1) To study e-Waste types in institutions of Thai higher education.
- 2) To investigate the progress of Thailand's Information and Communication Technology Policy for 2011 – 2020 (ICT 2020 or Smart Thailand 2020) under the strategy section 7.2 for Thai academic institutions.
- 3) To study of how the e-Waste is managed and handled in Thai higher education institutions.

### IV. CONCEPTUAL RESEARCH

The majority conceptual of this research is how can manage e-Waste by following ICT 2020 policy in strategy number 7.2 for encouraging people to be aware of every Life Cycle Assessment (LCA) steps and following the standard of ICT EcoDesign as 4Rs in every ICT product's cycle; reducing use of resources and energies (Reduce), repeating (Reuse/Repeat), recycling (Recycle) and repairing (Repair) in all ICT equipments in Thai higher education institutions as shown in Fig. 2.

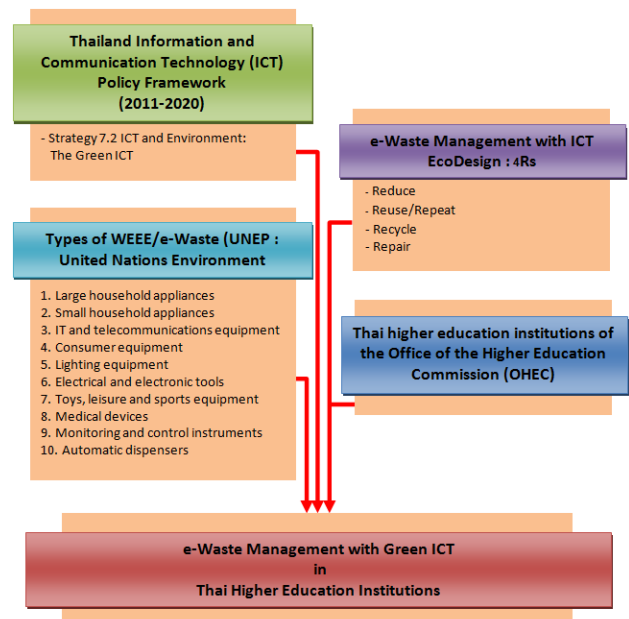


Fig. 2. Framework of the study of e-waste management with green ICT in Thai higher education institutions frameworks.

### V. RESEARCH METHODOLOGY

In this research, the researcher defines the processes into 3 periods follows by aims of the research:

#### A. 1st Period: Identify Types of e-Waste in Thai Higher Education Institutions

- 1) Population- refers to e-Waste management operators in Thai higher education institutions.
- 2) Sampling- refers to e-Waste management operators in Thai higher education institutions by using 'Purposive Sampling' in Thai higher education institutions of the Office of the Higher Education Commission (OHEC) -

the Ministry of Education. The data will be gathered from 10 persons in each 10 Thai higher education institutions; King Mongkut’s University of Technology North Bangkok, Khon Kaen University, Chandrakasem Rajabhat University, Rajanagarindra Rajabhat University, Rajamangala University of Technology Suvarnabhumi – Nonthaburi Center, Bangkok Suvarnabhumi Colleges, Ranong Community College, Southeast Asia University, North Bangkok University and Thonburi University.

- 3) Implementation Research-
  - Describe the meaning and types of e-Waste as well as e-Waste Management follows by ICT 2020 policy under strategy section 7.2 in the standard of ICT EcoDesign as 4Rs to interviewers.
  - In-depth Interviews e-Waste management operators in Thai higher education institutions about 10 types of e-Waste.
  - Analyses data of e-Waste management in Thai higher education institutions by using Content Analysis and Percentage Analysis of e-Waste.

*B. 2nd Period: Investigate the Progress of Thailand’s Information and Communication Technology Policy for 2011 – 2020 (ICT 2020 or Smart Thailand 2020) under the Strategy Section 7.2 for Thai Academic Institutions*

- 1) Population- refers to e-Waste management managers in Thai higher education institutions.
- 2) Sampling- refers to e-Waste management managers in Thai higher education institutions by using ‘Purposive Sampling’ in Thai higher education institutions of the Office of the Higher Education Commission (OHEC) - the Ministry of Education. The data will be gathered from 10 persons in each 10 Thai higher education institutions; King Mongkut’s University of Technology North Bangkok, Khon Kaen University, Chandrakasem Rajabhat University, Rajanagarindra Rajabhat University, Rajamangala University of Technology Suvarnabhumi – Nonthaburi Center, Bangkok Suvarnabhumi Colleges, Ranong Community College, Southeast Asia University, North Bangkok University and Thonburi University.
- 3) Implementation Research.
  - Describe the meaning and types of e-Waste as well as e-Waste Management follows by ICT 2020 policy under strategy section 7.2 in the standard of ICT EcoDesign as 4Rs to interviewers.
  - In-depth Interviews e-Waste management managers in Thai higher education institutions about e-Waste Management follows by ICT 2020 policy under strategy section 7.2.
  - Analyses data of e-Waste management by using Content Analysis follows by ICT 2020 policy under strategy section 7.2.

*C. 3rd Period: Study of How the e-Waste Is Managed and Handled in Thai Higher Education Institutions*

- 1) Population- refers to e-Waste management managers in Thai higher education institutions.
- 2) Sampling- refers to e-Waste management managers in Thai higher education institutions by using ‘Purposive

Sampling’ in Thai higher education institutions of the Office of the Higher Education Commission (OHEC) - the Ministry of Education. The data will be gathered from 10 persons in each 10 Thai higher education institutions; King Mongkut’s University of Technology North Bangkok, Khon Kaen University, Chandrakasem Rajabhat University, Rajanagarindra Rajabhat University, Rajamangala University of Technology Suvarnabhumi – Nonthaburi Center, Bangkok Suvarnabhumi Colleges, Ranong Community College, Southeast Asia University, North Bangkok University and Thonburi University.

- 3) Implementation Research-
  - In-depth Interviews e-Waste management managers in Thai higher education institutions about e-Waste Management follows by standard of ICT EcoDesign (4Rs).
  - Analyses data of e-Waste management in Thai higher education institutions by using Content Analysis.

VI. RESULTS AND DISCUSSION

*A. Types of e-Waste Management in Thai Higher Education Institutions*

TABLE I: THE PERCENTAGE TYPES OF E-WASTER IN THAI HIGHER EDUCATION INSTITUTIONS

Types of e-Waste in Thai higher education institutions	Percentage
1) Large household appliances	80.00
2) Small household appliances	60.00
3) IT and telecommunications equipment	100.00
4) Consumer equipment	100.00
5) Lighting equipment	100.00
6) Electrical and electronic tools	100.00
7) Toys, leisure and sports equipment	0.00
8) Medical devices	60.00
9) Monitoring and control instruments	70.00
10) Automatic dispensers	0.00

Table I illustrates types of e-Waste in Thai higher education institutions can be described into 8 types; 100% of Thai higher education institutions agreed that these 4 e-Waste types are the most e-Waste in the Thai higher education institutions; 1) IT and telecommunications equipment 2) Consumer equipment 3) Lighting equipment and 4) Electrical and electronic tools in every Thai higher education institutions follows by 5) Large household appliances for 80% of all Thai higher education institutions, 6) Monitoring and control instruments which using in some Thai higher education institutions for 70% of all Thai higher education institutions and lastly, 7) Small household appliances and 8) Medical devices for 60% of all Thai higher education institutions.

*B. The Progress of Thailand’s Information and Communication Technology Policy for 2011 – 2020 (ICT 2020 or Smart Thailand 2020) under the Strategy Section 7.2 for Thai Academic Institutions*

The research’s result founded that all Thai higher education institutions were unknown how could they applied the progress of Thailand’s Information and Communication

Technology Policy for 2011 – 2020 (ICT 2020 or Smart Thailand 2020) under the strategy section 7.2 for Thai academic institutions clearly.

### C. The Analysis of e-Waste Management in Thai Higher Education Institutions Result

The research's result founded that e-Waste management in Thai higher education institutions followed by each inventory department in educational institution customized policy which describes in 5 processes:

- 1) Selling distribution by bidding the unused or damaged electronic equipments to the licensed recycling business owner for the correct way to recycle e-Waste [2], [8].
- 2) Transferring or donation low efficiency electronic equipments to other department because the equipments were working inappropriately in that education institution but they are useful for others such as school, foundations to reuse or repeat those equipments.
- 3) Repairing the damaged of electronic equipment parts for reusing or recycle them by separating electronic equipments to spare the replacement parts or transfer or donation to others departments as shown in 2) [9].
- 4) e-Wastes that can not sell or donation or repair; especially lighting instruments such as Fluorescent lamps should be sorted out into bags or boxes separately then pass to the responsible local institutions such as Provincial Public Health Office or Bangkok Provincial Public Health Office to destroy [10].
- 5) Permitting the saving environment campaign; saving electrical by replacing LED lamps instead of Fluorescent lamps, saving water and public utility in Thai educational institutions by prescribing and announcing the electronic equipments manual regulations for saving energy [11].

According to the analysis of e-Waste management in Thai higher education institutions founded that the intuitions collected every electric equipments altogether; not separated them by the correct types of e-Waste except lighting equipments - Fluorescent lamps only as they known the bad effect of the Fluorescent lamps.

In addition, the methodology of e-Waste management in Thai higher education institutions is following by their custom methods which rely on electric equipments usage conditions and founded that the analysis of e-Waste management in Thai higher education institutions result is conformed to the ICT 2020 policy under strategy section 7.2. Even though, the Thai higher education institutions unknown the ICT 2020 policy under strategy section 7.2 clearly, they did manage e-Waste followed by the ICT EcoDesign – 4Rs [5] in operation.

## VII. RESEARCH FINDINGS AND RECOMMENDATIONS

### A. The Used of Research Result Recommendations

The Ministry of Information and Communication Technology and other government sectors related to e-Waste management should clarify the correct method, regulation and principle to education institutions for applying e-Waste management in their institutions in the same direction.

Moreover, the Ministry of Information and Communication Technology and other government sectors should teach the knowledge and understanding of e-Waste management to education institutions sustainability.

### B. The Research Opportunities for Future Research Recommendations

- 1) Should be study and develop the e-Waste management methodology with information technology and communication for environment in manufacture business owners who receive the e-Waste from Thai education institutions.
- 2) Should be do the research to develop the information technology and communication system for applying the appropriate e-Waste management in education institutions and conform to the ICT 2020 policy.

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