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Work Process of Bring Your Own Device to Support Green Computing

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ABSTRACT

Bring Your Own Device (BYOD) is a new approach to optimize the use of Information Technology (IT) devices to carry out their work task. The study of BYOD is focused on work activities that perform by IT worker using IT device in public sector. Work activities can provide important insights into IT device portfolio development, end-user segmentation process and the role of IT workers in public sector. The purpose of this study is to explore work process of bringing your own devices to support green computing. A conceptual framework of BYOD work process in public sector through integration of IT devices and end-user segmentation to support green computing was developed based on systematic literature review to highlight the implementation of BYOD. This framework considers that work activities based on IT worker, IT device portfolio and end-user segmentation are the main key for public sector to support green computing. This framework is an initial research for researchers and practitioners to further examine BYOD practices in public sector. In addition, to highlight an important gap, this paper explains how different work activities using different IT device influence the IT worker to select the suitable IT device for BYOD that support green computing.

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1. INTRODUCTION

Bringing personally owned devices to the workplace become a new trend in the organization. The practice of bringing own device, connect them to the corporate network and use them to perform work task for business purposes is a new approach for work strategy [1]. Bring your own device (BYOD) can optimize the use of Information Technology (IT) devices such as iPad, tablets, laptops or smartphones through the use of their personally owned IT device and organizational owned IT device to perform their task in workspace [2]. Besides that, the implementation of BYOD practices can support a green initiative by reducing the hardware from IT devices that will help to reduce carbon in the environment [3]. The new approach of reducing IT device can help to reduce negative impact on the environment because IT device is a major contribution to the disposal and IT usage [4],[5].

The concept of BYOD approach is suitable for several practices in the implementation of green computing in organizations. Green computing in organizations also become the trends in IT usage to reduce carbon emission and reduce electricity consumption. The benefits of green computing included reducing energy consumption [6], reducing carbon footprint [7],[8], reducing total cost of ownership [9] and e-Waste [6],[10]. The current practices of environmental concept focus on reducing the environmental impact by using green data centre approach, use green IT device, power management and materials recycling. These approaches become the best solution as green approaches to allow an employee to use IT devices in various

sector such as industrial, production, agricultural and construction [11]. It provides benefit to the organization in terms of electricity savings, reduction in environmental pollution, increases performance, increases productivity and savings in purchasing new hardware. These benefits play an important role in measuring green IT to ensure that the impact on the environment is minimized. They have a few key elements in green computing approaches such as telecommuting, voice over internet protocol (VoIP), power management [12], algorithmic efficiency [13], virtualization, material recycling and procurement [14],[15] that show the benefit of BYOD.

Organizations are using IT device to perform work task and most employees are allowed to bring their own IT device in the workplace. It is possible to control the multiple uses of IT device bring by the employee which contribute to waste of IT device and carbon emission. Therefore, reduce the carbon emission and waste in the lifecycle of IT device should be existing within the business processes as a core value [16]. Green computing captured the attention of Malaysian government and has introduced National Green Technology Policy (NGTP) by Ministry Energy, Green Technology and Water (KeTTHA) to promote and support the use of green Information and Communication Technology (ICT) [17]. Rising interest in green computing is highlighted in the Rancangan Malaysia ke-11 (RMK-11) as one the strategy towards advanced nation by 2020.

End-users play an important role in green attitudes and behaviour of the organization's workforce towards environment [18]. However, the different end-user needs the different hardware based on usage pattern and location requirement that including job specification, time, a value derived from mobility, data access and system access [19]. It is still not clear what the main components of BYOD that must be considered to support green computing. In Malaysia public sector, there is an on-going promotion of green initiative but there is still lack of BYOD work process about what BYOD component and green computing approach involve.

2. PROPOSED FRAMEWORK

This study aims to propose a conceptual framework of how the work process of BYOD can be developed based on the integration of the model's reviews in the literature, work activities from organization practice, IT device portfolio and end-user segmentation. The elements from each of the process will reflect the impact of the implementation of BYOD within the proposed BYOD work process framework in public sector in order to support green computing initiative. It shows three main relationships identifies through the BYOD implementation in public sector. The model starts with work activity from the organizational level which highlights the issues of work activities to perform the work task. The issues of work activities not being standardized are one important factor that happens in public sector. In order to implement BYOD, work activities will be clustering based on the type of task. The output from this level will be used in two type of level which is technology level and end-user level. The process of both levels is parallel to identify suitable IT device and to identify the segmentation of end-user in public sector to support BYOD implementation. Therefore, the study will explore these relationships to help develop the framework that can be implemented in the public sector to support green computing. Figure 1 shows the conceptual framework for BYOD work process to support green computing.

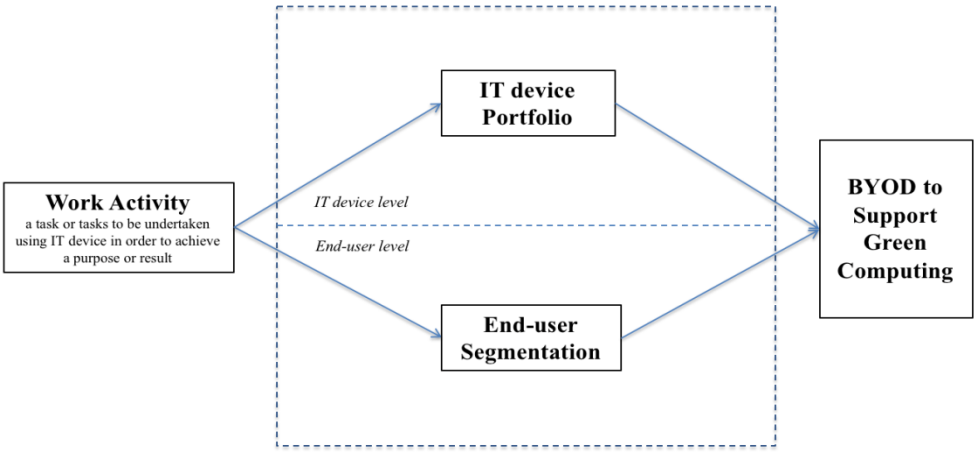

Figure 1. A Conceptual Framework for BYOD Work Process to Support Green Computing

2.1. Organizational Level

The initial process in the framework is to manage work activities at the organizational level. BYOD expected to be related to work activities including the type of work task, work sensitivity and organization hierarchy. Work activities also can predict IT devices. The work activities for IT worker contain a different work background and hierarchy of IT worker. In order to cluster the work task based on the characteristic, the organization needs to cluster the work activities based on job criticality dimension. According to prior research, work activities for BYOD uses job criticality dimension as the main dimension technique [19]. The usage pattern of work activities is depending on their job role in organization, functions and their decision making that impact on the organization [20]. Thus, work activities for IT worker focus on performing the task using IT device in public sector.

2.2. Technological Level

At the technological level, IT devices play an important role in work activities to perform work task in the organization [21]-[23]. This process is to identify suitable IT device portfolio to support BYOD for end-user in public sector. In order to select IT device, the organization needs to identify what type of IT device that can access the organization resources in workplace and the ownership of each of the device [24]. Using ICT technology that include IT device, application, system, data and organization's network in organization can help to increase task performance [25]. However, IT devices were difficult to handle because of the different types of data and sources. Hence, suitable IT device needs to be identified to make sure all the data can be accessed to perform work task [26].

2.3. End-User Level

End-user is a major part of BYOD implementation. Selection of BYOD device depends on end-user needs in terms of security, access to applications, device preferences and need for mobility [24]. Different end-user may have different work activities which will influence their needs to use different IT device to perform the task. End-user segmentation can help to minimize negative effects of using IT technology. The use of end-user segmentation based on work activities can reduce work overload [27] and overlap [28],[29]. They can help to reduce and optimize the use of IT device in work activities to improve productivity and work performance [30],[31].

2.4. Green Computing Level

This level shows the integration between technological level and end-user level to support green computing. Since the work processes of BYOD are not fully utilized, it led to waste of IT resources in the organization. Six major component that related to BYOD which are device choice, affordable, technical component, content, liability and sustainable was analyzed to map the benefits and provide advantages to support green computing.

3. RESEARCH METHOD

This study adopts systematic literature review activities that consist three main phase such as plan review, conduct review, and document review [32] (Table 1).

Table 1. Systematic Literature Review Phase

Phase	Process
Plan Review	1. Specify Research Question 2. Develop Review Protocol 3. Validate Review Protocol
Conduct Review	4. Identify Relevant Research 5. Select Primary Studies 6. Assess Study Quality 7. Extract Required Data 8. Synthesise Data
Document Review	9. Write Review Report 10. Validate Report

The first phase of conducting a literature review is to plan the literature review by identifying the objective of the study. Three primary objectives of this study are: to identify work activities for the employee to perform the task using IT device; To identify end-user characteristic to support BYOD implementation and; to identify IT device for BYOD to support green computing. Then, the protocol will be developed to specify the procedure to be followed for the second phase. The validation will be performed by the external

reviewer to review the quality of the protocol. Once the protocol is complete, a search strategy evaluates a comprehensive of the literature related to the research topic by reveal information from various databases such as *ACM Digital Library, IEEE Xplore, Google scholar, Springer, and Taylor and Francis Online*.

To utilize the literature findings, open-access journals in the related domains were also included. The strategy to develop the process started by identifying the most used words in the research to show the approach of BYOD and any relevant relationship between using IT device and green computing by the end-user in public sector. During the searching process, all relevant literature review also included except security perspective. The searching also not limit the year of publication. The following search string was used to search the focus keywords: *("BYOD" or "bring your own device") AND ("green computing" or "end user" or "mobile device")*

After the searching process, all selected articles and journal are evaluated based on criteria that focus on this scope described in Table 2. Before the data is extracted, each of the paper was assessed by the external reviewer to check the data. As the result, 35 articles were finally selected from the total of 100 articles. These results were analyzed in order to highlight the relationship between BYOD, IT device, end-user and green computing.

Table 2. Evaluation Criteria

Include	Exclude
1. Directly or indirectly related to both BYOD and green computing	1. Irrelevant to study of the BYOD or green computing
2. Green computing solution related to IT device	2. Security approach or solution for BYOD
3. Benefit of BYOD to support Green computing initiative	
4. IT device and end-user solution for BYOD to support green computing	

4. RESULTS AND ANALYSIS

As a public sector, the work activities using IT device increasingly transform into an important process to perform the work task. The implementation of BYOD to support green computing initiative will affect by different IT device to perform work task in public sector. The IT department has a main role in the transformation of work activities to support green computing. It has to understand the importance of work activities, the suitable IT device, end-user and how to support green computing. The current guideline of BYOD only limited to the security issues that led to difficulties to the public sector to implement BYOD which can support green computing.

The first framework analyzed in literature is work activity, IT device portfolio for BYOD and end-user segmentation is shown in Figure 2. There is the different level of the implementation of BYOD which show the relationship between work activity, IT device and end user. This framework maps the IT device and end-user segmentation within the work activities perform by IT worker in public sector. Once the mapping is complete, a suitable IT device for BYOD is developed. The components shown in the framework are as follows:

1. Identify the task that using IT device in the workplace
2. Identify the suitable IT device in public sector
3. Determine the suitable IT device to support BYOD implementation
4. Develop an IT device portfolio from the findings to support BYOD
5. Determine the end-user within the IT department by exploring how IT workers use IT device for BYOD implementation
6. Determine the characteristics of the end-user that support the implementation of BYOD
7. Develop a segment for end user that support BYOD
8. Develop a work process of BYOD through relationship between IT device and end-user.

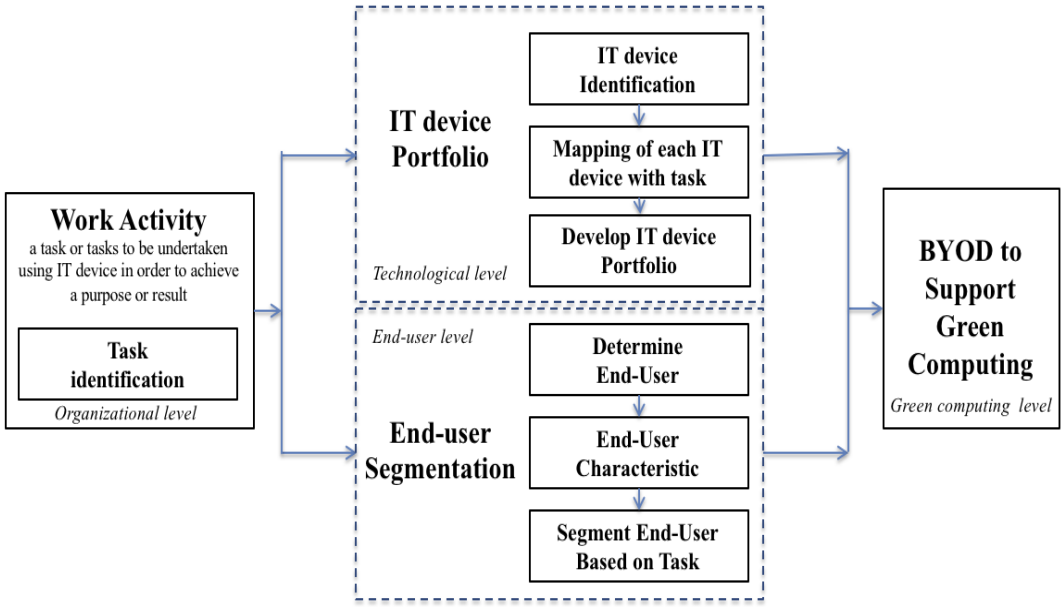

Figure 2. A Proposed Framework for Work Activity, IT Device and End-User Segmentation to Support BYOD

The second framework on IT device using by IT worker to perform work task and influencing factors to support Green Computing is shown in Figure 3. The framework provides the suitable IT device selection for BYOD implementation based on BYOD component that supports green computing. The framework shows six components of BYOD from green computing perception. These include device choice, affordable, technical component, content, liability and sustainable. The component of BYOD aims to bring benefits that can provide advantages to support green computing. It focuses the need to reduce environmental problems through reducing the IT device usage. It is characterized by the benefits of green computing approach such as telecommuting, voice over internet protocol (VoIP), power management, algorithmic efficiency, virtualization, material recycling and procurement [14],[15].

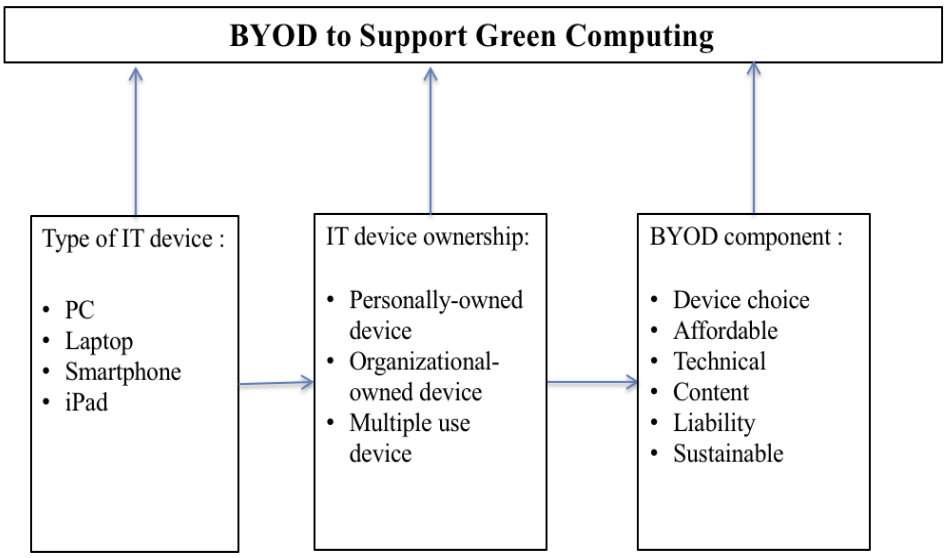

Figure 3. A Proposed Framework on IT Device and Influencing Factors to Support Green Computing

A different IT device may influence the use of IT devices and implementation of BYOD to support green computing in public sector. BYOD component has the benefit to contribute to the green initiative. An

example is the choice of IT device, where the employee selects the IT green device that also affordable for them. Through this selection of the device, the employee can choose the green device, help to reduce IT support, maintenance and pay for the latest device which consists less energy consumption and carbon emission [13],[14],[33]-[35]. The organization allows the employee to use their IT device and connect to the organization resources. This process can be achieved by providing IT support in term of infrastructure, content, liability and sustainable to connect any devices to access organization's data or system [36].

The framework also provides the main work processes of BYOD implementation. It focuses that three type of IT device ownership from public sector perception which reveal the relationship between ownership of device and interaction with work task. These include a personally-owned device, organizational-owned device and multiple uses of IT device. It focuses the need of BYOD to support green computing that characterized by four type of IT device such as PC, laptop, smartphone and iPad to perform the work task. The first type of BYOD uses IT personally-owned devices for performing work task. The employee can bring their own IT devices such as smartphone, laptop and iPad at the workplace and connect their device to organization resources. The organizational-owned device is IT device that provided by the organization to the employee to perform the task. In this type, all the resources will be controlled by IT department as well as data information and devices. The next type involves multiple use of IT device, in which organization allows their employee to uses multiple IT device for more flexibility and access in the workplace.

The purpose of this framework is highlighting the concept of BYOD that can support green computing from different factor in the public sector. These frameworks provide a work process as a guideline to the public sector that gives them with new perspective and understanding related to the green initiative.

5. CONCLUSION

Malaysia is moving towards advanced nation by 2020 which different dimension and multiple focuses such as the economy and technological progress. At the same time, the public sector is expected to highlight awareness and implementation of green computing practices to reduce environmental impact. KeTTHA is a ministry that responsible for green initiative towards environmental protection by implementing green policies and to help organizations manage issues related to the green initiative.

The framework is developed to focus research on work activities, the relationship between IT device and end-user and how it can support green computing in public sector. The framework is constructed with component and benefit of green computing that is mapped from a review of the literature on work activities, green computing, IT device and end-user segmentation. The conceptual framework has the potential for guiding researchers to enhance knowledge for BYOD that can support green computing. The framework helps clarifies the contributing work process of BYOD and its impact on green computing approach.

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