

# Implementing Smart Mobile Application to Achieve a Sustainable Campus

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**Abstract**— The use of technology nowadays is not an unusual matter especially in universities. The use of computer technology and the advanced networking that creates an integrated services and enables communication among the community of universities is a concept in a digital campus. However, in the education sector, the digital campus needs to be built as an essential foundation for the modernization of education and to facilitate a better campus life. This paper presents the concept and framework of Digital Campus as part of the university's challenges in fostering an economical and socially sustainable campus. The implementation of co-created value in framework increases the efficiency of the digital campus concept. The use of mobile applications is very appropriate for achieving campus sustainability because of its increasing significant and ability. UKM Mobile Application as part of Digital Campus strategy is seen to be able to contribute to the sustainability of the campus. We also present the implementation of Digital Campus based on smart card usage in the applications such as attendance system, canteen payment and academic services. Mobile application development embedding value co-creation can improve the quality of service in terms of good communication with customers and the best services to the university.

**Keywords**— *Digital campus, mobile app, smart card, sustainable campus, value co-creation.*

## 1. Introduction

The rapidly changing in technology development has changed people's thoughts, ways of their

thinking, learning, working and life [12]. Therefore, everybody including any company either government or the private sector cannot be left behind in technological development. Similarly, in the education sector, digital campus has to be built as an important basis for the modernization of education. Digital campus integrates physical space and digital space in order to change the interaction of university community with university resources and the environment [11]. The criteria such as digital network environment, digital learning resources and environment, digital management tools and working environment have been measured for a better education nowadays. However, the development of digital campus requires an integrated concept including economic viability, status, size, lecturers, students and many more elements [13]. In this aspect, sustainability is one of the key challenges that future learning environments and campus development face [8]. In Digital Campus, we use value co-creation as the underlying concept for sustainability. In order to be sustainable, the digital campus form and function has to be co-created with its stakeholders. Thus, the inclusion of the stakeholders, in particular the users of the services afforded by the Digital Campus, in the co-creation of digital campus services is necessary to ensure the continual use of the offered services.

## 1.2 Definition of digital campus

A campus is a piece of land on which buildings of an educational establishment are constructed such as libraries, classrooms, residential halls, student centres, dining halls, and recreation areas. There are various definitions of digital campus but digital

campus is commonly referred to as a network based on the use of advanced computer technology, networking and communication to the campus network [12]-[13]. [11] defines digital campus as a single online environment open to all that is personalized to individuals' current interests and relationship with the university. Digital campus acts as an integrated bundle of services, capabilities, and practices that enable the users to electronically and seamlessly conduct transactions, acquire and provide content, and communicate with each other. Thus, the digital campus is a design that enables the user to communicate with one another and have integrated access to all of the campus functions based networks.

### 1.3 Sustainable Development

Sustainable development has various definitions due to different perspectives. In Brundtland's definition [3], sustainable development means the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. However, due to the changing world, the new definition of sustainable development is defined as the kind of development that uses the available capital in the present without compromising the ability of future generations to use the same capital [1]. Three aspects are considered in sustainable development, which are economic, environment and social [8]. Education is part of elements being considered in social aspect.

Sustainable development in education is a relatively new and emerging area of research. The technological era nowadays urges education for sustainable development. The education needs sustainable development through its traditional missions of education, research and public service [12]. In higher education, universities play important role in promoting sustainable development and generating awareness in future leaders about the sustainable development. Sustainable development in education is not limited to providing training in resources management but also in managing productive activities in order for being economically and socially sustainable [9].

Creating a digital campus is one of the key initiatives for innovative and sustainable development. The digital campus offers the university a sustainable platform as it has the digital environment and makes its information and tools invaluable for the university communities

[11]. Thus, this paper presents the basic concept of digital campus to improve the educational environment and support the sustainability of the universities towards the realization of a sustainable Malaysia.

### 1.4 Framework of Sustainable Campus

[4] has design the framework for the sustainable university model as in Figure 1. In this model, the committee plays an important role in creating the comprehensive campus-wide policies, targets and objective. They are at the main decision-making level. In a way in creating sustainable university, the committee must be formed with the representative of other university community. Then, if possible, also involve the honourable members of the surrounding society. This sustainable university model presents a systematic procedure for how people are responsible for sustainability initiatives. However, the effort in implementing the sustainable university model is a long process of improvement economic performance, social and environmental that should be in incremental steps.

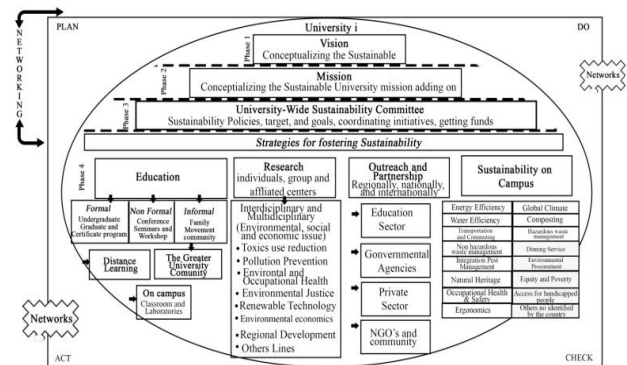
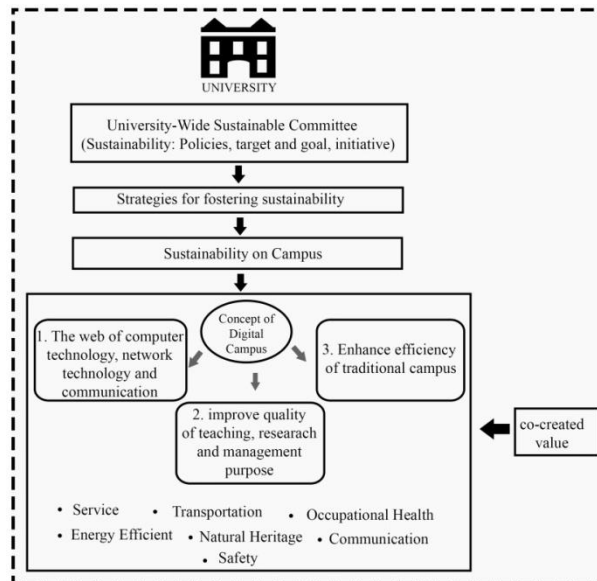


Figure 1. The proposed sustainable university model [4]

## 2. Proposed Framework

The framework of Digital Campus in Figure 2 shows the concept of Digital Campus which is implemented as a main part to support sustainability in campus. The basic idea of the proposed Digital Campus concept is towards a better university with the updated technologies. In this framework, we use the main definition of digital campus from [13] as the main part of the framework. The concept of Digital Campus implemented is service, transportation, energy efficient, occupational health, natural heritage, communication and also safety.



**Figure 2.** A framework of Digital Campus to support sustainable campus

The proposed framework for digital campus concept is focusing on the service that embeds co-created value to improve the quality and value of service. Co-creation is a process that resulted from the interaction between the organization within customers and users in using the services [9]. Customer co-creates the content based on their experience and personal needs instead of the organization itself.

In Digital Campus, we can use the co-creation value as an idea to create sustainability. In order for creating sustainability, it is crucial to determine together with the customer what the digital campus is and how it is supposed to be developed in the future. Sustainability is one of the key challenges that future learning environments and campus development faced [8]. Thus, the feedback from customer is a main thing in co-creation process to maintain customer in using the offered services continuously.

A survey was given to the student to see how the need of using an application as the technology is advancing. The questions randomly asked about the services they use, the things that they need as a user and the future technology that they want it to be there in helping to improve the quality of service. They also shared the problems that they are facing and the facilities that are supposed to be there. Together, the user and the service owner co-create on the service available for a better futures and relevant content for the services [2].

Among the two reasons of the benefit of co-creation value, the first thing to do is increasing the innovation capacity [10]. In our research, many

people are involved giving out ideas and opinions on the applications that we are going to develop. Next is to increase innovation velocity. We get the source from the right person to minimize the time consumption to get the innovation idea and concept. By choosing a correct target, we reduce the innovation risk. People who are involved in co-create the community is one who uses the service. As we choose the correct person, we can get better quality ideas and concept into the development. By applying the co-creation, time to use the product might be faster.

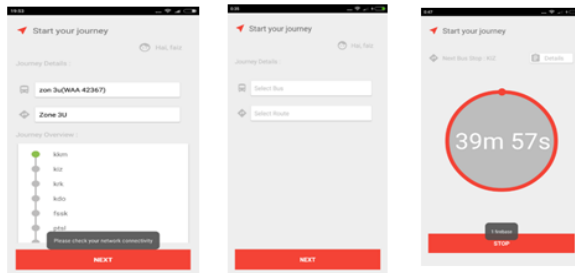
### 3. UKM Mobile App

As the proliferation of smartphones continues to rise, the education sector has finally embraced mobile into their digital strategy to enhance communication with current and prospective students. There are now many universities that have mobile apps and this trend will continue to rise. Universities and colleges have identified a number of key areas where direct communication with students through their mobile devices can assist them in putting information at their fingertips quickly and efficiently. Applications that provide interactive maps to help students with directions when they first arrive on campus, study schedules that are automatically synced with their mobile calendar, staff m-directories, m-payment services and access to course work are all value laden services that will ease the students' lives on campus. Universiti Kebangsaan Malaysia (UKM) has been developing mobile applications as services as part of its Digital Campus strategies.

#### 3.2 UKM Bus Tracker

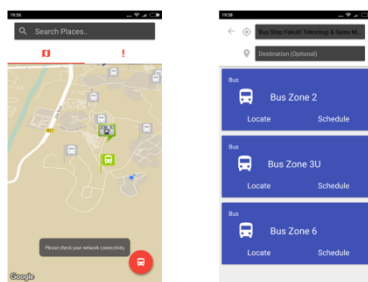
From this application, user will be able to get information of the bus approaching the destination with estimated time, and allows the user to check the current location and status of bus (Figure 3). Feedbacks can be sent via mobile application to provide immediate updates and push notifications will be delivered instantly to connected users. This application included 2 sub-modules and 1 admin system.

In the Driver Module, the driver needs to select the bus and route before depart. Timing will start count down until the trip finished (40 min).



**Figure 3.** Bus Tracker Driver Module

The User is able to check their current location and check the current location of each bus and also the user can choose their destination and check the buses that will pass by that bus stop (Figure 4).



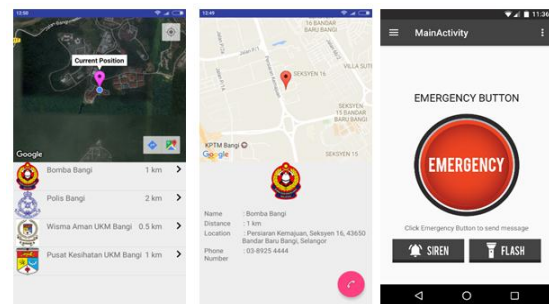
**Figure 4.** Bus Tracker User Module

The application has been tested by students in campus as they are the main user of the service. The students are given the information about the bus route and the zones covered by the bus which are zone 2, zone 3U and zone 6. The students test the application in a real situation where the test start from waiting the bus at the bus stop, riding the bus and arriving at their destination. The student test whether the bus is punctual or on time while waiting for the bus, identify the crowded drop zones and the delayed bus, and find out the duration of bus arrives at the destination. In the application, the user can view the location of the bus either by map views or line and bullet. They can also choose the feature of the application such as show an arrival times, receive an alert when the bus is coming, suggest the bus route with the chosen departure and arrival location, and comment on the bus services or the application itself. There are 121 students did the test. They give a good suggestion to improve the application such as to make the application more interactive and user friendly, include the Rapid bus services instead of the campus bus in the application, make the application available during the short semester, and reduce the data connection while using the application. Most of the respondent are interested

in testing the application with 102 students answered 'yes'.

### 3.3 Emergency Dial

This application provides information, location and contact of all emergency departments near UKM. Users will have a direct link to google map for the final destination. Users can save emergency contact number manually. When the users click on the EMERGENCY button, it will automatically send an emergency message to the Personal Contact (Figure 5).



**Figure 5.** Emergency Dial

The application is near completion. This application is built for android user only. Some of the interface has been changed and improved as in Figure 6.



**Figure 6.** Emergency Dial

#### 4. Smart Card Based Digital Campus

Institut Teknologi Bandung (ITB) has developed digital campus applications based smart card as shown in Figure 7. Using this system, we can achieve the objective of digital campus, such as improving the quality of teaching, research management, communications, academic services, safety, as well as energy efficiency. Using smart card usage, we can create many applications such as class attendance system, room access control, academic services, canteen payment, etc. Moreover, we can track the student activities and perform student behavior analytic based on student's smart card usage. Following are several digital campus applications that have been developed in ITB.



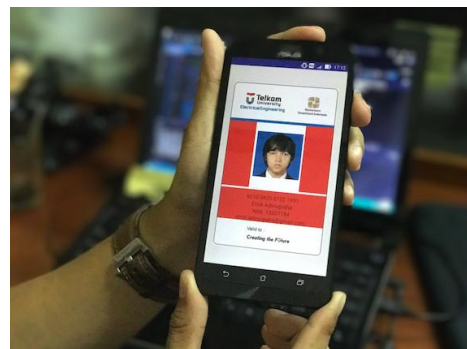
**Figure 7.** The ITB smart card used for digital campus applications

#### 4.2 Class Attendance System

In this application, smart card is used to check the attendance of the students in the classroom. Instead of hand signature, they can use smart card to check in to the class. Every classroom will be equipped with smart card based access control. This access control is connected to the cloud server. Using this method, we can digitally collect the attendance of students' data. Moreover, this system can be used also for room management system. Before the semester start, university can make web based lecture schedule, including classroom allocation. If the students access the allocated classroom within the scheduled time, they will be automatically registered as attendance of the lecture in that day. The proposed system will increase the user experience and the academic quality of service as well as security system.

#### 4.3 Academic Services

In this application, the smart card is used to securely store student ID and personal academic information. We have developed a portable smart card reader that can read the student information inside the smart card, and send the information to smartphone via Bluetooth® as show in Figure 8. Smart card not only store the student ID, but also information such as biometric, signature, photo, academic transcript, health record, etc. Therefore, this smart card can be used to securely access web based online student information system. Instead of using password, student can insert their smart card to login to web based student information system. Inside the student information system, the authorized student can access many other applications based on student information stored in the smart card, such as application for scholarship, student grant, academic transcript, selecting lecture, lecture schedule, etc. For very secure information, we can also use biometric information inside the smart card to do student authentication. By doing authentication, we can guarantee that the smart card holder is a registered student.



**Figure 8.** The student ID check using portable smart card reader

The smartcard based smart campus system has been deployed in five universities in Indonesia as a pilot project. The system need to be deployed in several stages until full deployment. The deployment shows the systems has been working and gain interest of the student as well as increase the efficiency. The mutual authentication method in smart card data access has been employed for the security features. DES and AES for data encryption have been used. For the cloud access, the data has been encrypted to increase the security.

## 5. Conclusion

The aim of this paper is to give a basic concept of digital campus and campus sustainability. The framework can be implemented in the universities in future as it will give a basic idea on how to create a digital campus. The example of digital campus in UKM and ITB based on mobile application and smart card system have been also presented. Most of the feedback from respondent and users is positive as the mobile application can increase the efficiency and make things work easier.

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