**MobileApp development methodology for a Green IT environment**

**Under**

**Sustainable Computing**

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**Abstract**

Green Computing, Green IT or ICT Sustainability is the studies and practices of environmental sustainable computing. Green Computing is “where organization adopts a policy of ensuring that the setup and operations of IT produces the minimal with carbon footprints and reducing efforts”.

Sustainable Computing is related with energy law and mobility management. Mobile is for mobility, reduce the usage of paper comes under the term Sustainable Computing.

Sustainability is a widely used term and refers to the capacity of something to last for a long time. Sustainable Software is great term in which I am concerning with ‘Green within software’ means with the tools used for designing and development of the system.

My research is about the tools that are used in Mobile Application Development that are used for cross development for different environments.

Most cross-platform development tools promise you can build your codebase once, and then run the app on any platform. Why build natively for every different platform, if you can build it once and deploy on as many platforms as you want?

Keep in mind that cross platform mobile development isn’t quite as simple as writing the code once, putting it through a tool for translation, and publishing both an iOS and Android app and on web. Using a cross platform mobile development tool you can reduce the time and cost associated with developing apps on multiple platforms, but the UI needs to be updated to match each system. For example, adjustments are needed between the two so the menu and control commands match the UX of how Android devices and iOS devices operate inherently differently.

Next Choice we have to make with native vs. Hybrid app development. Native mobile apps for cross platforms are written with specific platforms and devices in mind. While these can be preferred for complex consumer-facing apps, they generally take longer to develop, are more expensive to create, and require experienced developers with knowledge of various coding languages. As a result, they are not ideal for internal business applications.

Cross platform hybrid apps are a common choice for building enterprise apps as they often leverage rapid mobile app development (RMAD). These are low-code development tools that quickly build business apps using a single code base, and puts apps in native device wrappers for the developer. These apps run on mobile devices of all types.

**1.1 INRODUCTION**

The Burundian report from the United Nations (UN) defines sustainable development as the ability to ‘meet the needs of the present without compromising the ability of future generations to satisfy their own needs’. According to the UN, sustainable development needs to satisfy the requirements of three dimensions, which are the society, the economy and the environment.

Sustainable software is ‘software, whose impacts on economy, society, human beings, and environment that result from development, deployment, and usage of the software are minimal and/or which have a positive effect on sustainable development’. These authors subsequently use the same definition for the concept of green and sustainable software. They therefore define green and sustainable software as ‘software, whose direct and indirect negative impacts on economy, society, human beings, and environment that result from development, deployment, and usage of the software are minimal and/or which has a positive effect on sustainable development’. They consider that direct impacts are related to resources and energy consumption during the production and use of software, while indirect impacts are effects from the software product usage, together with other processes and long-term systemic effects.

Green software is ‘an application that produces as little waste as possible during its development and operation’.

When we are talking about Green Computing, We have two aspect of discussion. One aspect is ‘Green with Software’ in which we have the concept of Cloud Computing, IOT, Dematerialization, Virtualization etc. that comes under Green IT 1.0 and other aspect is ‘Green within Software’ in which we are giving importance to Product ,Process, Usage, Libraries , Design , Development utilization in effective way that comes under Green IT 2.0.

Sustainable Software

Green Software

Green with Software

Cloud Computing

Internet of Things

Dematerialization

Virtualization

……..

Green within Software

Product

Process

Usage

Design

Development

….

**1.2 RESEARCH QUESTION**

In this research paper, I am going to focus on the following research questions:

• What are the meanings of the terms sustainable and green related to software area?

Sustainability is a widely used term and refers to the capacity of something to last for a long time. In the software area it is related to develop a sustainable green computing plan, Recycle the working flow, Make environmentally sound purchase decisions, Reduce Paper Consumption, Conserve energy.

• How is it possible to establish sustainable and green software engineering process?

Sustainable and green software engineering process respecting the meanings of the terms defined for energy law and mobility management. Cross-platform development is the practice of developing software products or services for multiple platforms or software environments. Engineers and developers use various methods to accommodate different operating systems or environments for one application or product. The contribution of this way of working is to add a green analysis by reducing the workflow and manpower consumption and complexity of writing multiple codes for different environment for similar way of working.

• How to help and guide developers to optimize their source code in order to build efficient, sustainable and green software?

Sustainable or Green computing implies to help and guide developers to in respect of several criteria like Reusability of code , Reduce the energy consumption, Reduce the efforts and optimize code with single codebase.

• How the common quality criteria are important for sustainability of System?

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The common criteria arise out of the well"known and

standardized quality aspects for software, issued by the

International Organization for Standardization [16]. The

proposed Quality Model takes aspects, like  into

account as well as e. g. , , and .

These quality aspects reach into the field of SD [3].

The quality aspects belonging to efficiency, next to 

, are  ,  !", 

, #$ ", ", and %  $.

In this case, " describes how often the system is idle. This

aspect is only relevant to certain types of software systems, such

as virtual servers [29]. The total %$ reflects the

size of applications [7]

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size of applications [7]

Common quality Criteria arise out of the well known and standardized quality aspect for software, issued by the International Standardization Organization. The proposed tool takes aspect like Efficiency, into account as well as Reusability, Modifiability and Usability for sustainability Development.

**1.3 CONCEPTUAL FRAMEWORK**

Green IT is also related with recycling of all electronics devices, including phones, printers, computers, television etc. means hardware but my concentration with Software where we are more giving importance to limiting printing and recycling papers and Single codebase for multiple applications.

Green I.T 1.0 is the greening of I.T by laying emphasis on re engineering I.T products and processes to improve the energy efficiency of I.T and minimization of their carbon footprint and their environmental impact. Green I.T 2.0 is the greening by I.T and includes coordinating, re engineering and optimization of the supply chain, manufacturing process and workflow of the organization to reduce the impact on environment [4].

**1.4 APPROACHES TO GREEN COMPUTING**

Green Computing approaches includes

* Algorithm Efficiency
* Power Management
* Display
* Recycling
* E-waste management
* Make low power using machines
* Reduce printing

**1.5 TOOLS ANAYLSIS**

In this area of tools representation, my aim is to briefly present the different organization tools/products that are used in Cross platform mobile application development with their usage. As my area of concern is ‘Green in Software’ in which I am pushing towards the product usage for maximization.

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| **Sr.No** | **Tool Name** | **Details About Tool** |
| 1 | 5App | 5App is a unique tool designed specifically for businesses into learning, HR consulting, and firms that want to organize and deliver resources to their employees or to the right people at the right time.  5Apps uses HTML5 and JavaScript for coding of apps and emphasis on the security of app data. The tool allows you to quickly create relevant content to support your employees’ learning and performance.  The finished app is compatible with both Android and iOS devices, so you can choose accordingly as per your company’s needs. |
| 2 | Alpha | [Alpha Anywhere focuses on the enterprise and can be used to produce cross-platform apps for major mobile operating systems, as well as for PCs and Macs. It uses JavaScript and HTML5. A recent addition to the platform allows developers to create apps that can be used offline.](http://www.alphasoftware.com/alpha-anywhere-2.asp" \t "_blank) |
| 3 | Appcelerator | [This tool makes it possible for coders to create cross-platform apps with speed. The tool deploys a JavaScript codebase. The plus point of this tool is it is extensible and open. The developer can create apps for platforms like framework Alloy.iOS, Android, and BlackBerry; it even supports HTML5 and hybrid apps. The Appcelerator tool has an open-source SDK and supports more than 5,000 devices and OS APIs, Eclipse-based IDE Studio, and the MVC.](http://www.appcelerator.com/" \t "_blank) |
| 4 | Codename One | Codename One is a cross-device platform with goals of simple usability, rapid application development, and deep integration with the native platform with possible native speeds. While you’re required to code in Java, Your application can also be tested & verified with Codename One’s simulator devices and test automation tools. |
| 5 | Convertigo | Convertigo is an open-source software vendor that provides a mobile enterprise application platform consisting these solutions: Convertigo Studio, Convertigo Studio, Convertigo Server, Convertigo Cloud and Convertigo Mobilizer.   * It lets you create business-driven events computed to notify users, even if the device is in standby mode. * It allows connecting to enterprise data with a variety of connectors such as SQL databases or web services with its Full sync data replication technology, data can be made available locally even if the network is not accessible. |
| 6 | Corona | Corona is a cross-platform ideal for creating games and apps for mobile devices, desktop, and tv devices using just one code base. This tool speeds up your coding process and you can easily update your code, save the changes, and instantly see the results on real devices. With Corona, your apps are optimized for performance because of the lightweight scripting power of Lua that enhances your app performance at every level. Corona is free to use cross-platform app development tool that primarily used in 2d games as it’s great to use for high-quality graphics and high-speed development of games. |
| 7 | FeedHenry | Recently purchased by Red Hat for about $82 million, FeedHenry offers a mobile-as-a-backend service as well as cross-platform app development. Apps created for Android and iOS with the platform can be offered either through the cloud or on-site. Scalable network apps can be created with the platform using Node.js and MongoDB. |
| 8 | Flutter | Powered by Google, Flutter is a power player when it comes to delivering first-rate native experiences on Android and iOS platforms. Flutter is growing in popularity and often compared with React Native and other best cross-platform app development tools. It uses Dart, a programming language developed by Google and also uses many advanced features of popular programming languages. |
| 9 | iFactr | iFactr is also designed for speedy delivery of apps. The solution can be learned with minimal spending of sweat equity. Developers can start hammering out apps after just two or three days of training , according to iFactr. Prototypes can also be rapidly created for quick feedback from employees. iFactr uses Xamarin to create iOS and Android apps, and the solution also supports Adobe PhoneGap. |
| 10 | Intel XDK | The Intel XDK is a comprehensive cross-platform development environment for cost-effectively creating, testing, debugging, building, and deploying HTML5-based hybrid mobile apps and web apps. It also supports developing Internet of Things Node.JS apps that use an Intel maker board. |
| 11 | Ionic | A Cross-platform app is an app that can be used on multiple platforms using a single code base. As ‘cross-platform’ and ‘hybrid’ apps are almost similar accept several structure and technologies differences, we are referring here Ionic as a cross-development app development tool. This is because , using Ionic as a cross-development hybrid apps(refer official website here) for web ,native iOS, and Android platforms. |
| 12 | JQuery Mobile | JQuery Mobile is a user interface framework, built on jQuery Core and used for developing responsive websites or applications that are accessible on mobile, tablet, and desktop devices. It uses features of both jQuery and jQueryUI to provide API features for mobile web applications. |
| 13 | Kony | Kony Mobility Platform is an integrated, cross-platform mobile app development platform that can be used to build universal mobile applications. Kony Mobility Platform provides automatic coding features, app preview facility, API connections and many more features. • It comes with various pre-built apps that act as a great starter for developers • It offers unified mobile infrastructure services for supporting backend systems • Its visualiser acts as the frontend to its powerful multi-channel JavaScript APIs |
| 14 | Monaca | Monaca makes HTML5 hybrid mobile app development with PhoneGap/Cordova simple and easy. Monaca is the most open hybrid app development platform available and ready to be immediately plugged into your existing workflow and development environment. From Cloud IDE, CLI to debugger and remote online build, everything you need for your hybrid app development |
| 15 | Monocross | Monocross is an open-source cross-platform mobile framework that lets you create beautiful applications for iPads and iPhones, Android smartphones and tablets, Windows Phone and Webkit-enabled devices. Monocross uses C#, Microsoft .NET and the Mono framework for developing multi-platform supported apps. • It gives you access to the full power of the native device APIs while still coding in C# • It gives access to several APIs you need to securely deploy your apps; there is no need to learn the low-level intricacies of every platform • Using Monocross to develop apps requires only C# and .NET compatibility for the apps’ continual development and maintenance activities |
| 16 | Native Script | NativeScript enables you to build truly native apps for iOS, Android, and the Web, from a single JavaScript code base. With support for TypeScript, CSS, and popular frameworks like Angular and Vue.js, {N} lets you build awesome mobile apps with technologies you already know. |
| 17 | OnsenUI | Onsen UI is an open-source UI framework and components for HTML5 hybrid mobile app development, based on PhoneGap / Cordova. It allows developers to create mobile apps using Web technologies like CSS, HTML5, and JavaScript. |
| 18 | Phone Gap | PhoneGap is owned by Adobe and is one of the best cross-platform development tools to use in 2019. It’s based on the open source framework Apache Cordova that gives you access to complete set of PhoneGap toolset which helps streamline the app development process and include the options: Debugging tools allow you to inspect HTML, CSS, and debug codes in JavaScript. |
| 19 | QT | Qt is the best cross-platform tool for mobile app development. Why I’m counting this tool in the best cross-platform tools is because of its quality features that allow creating fluid, UIs, applications, and embedded devices with the same code for Android, iOS, and Windows. |
| 20 | React Native | Backed by Facebook, React Native is a mobile app development tool to build cross-platform apps on iOS, Android, and UWP platforms with an ability to deliver native-like performance. It is used by many tech giants such as Instagram, Facebook, Airbnb, Walmart, Tesla, UberEats, and so on. |
| 21 | Rhomobile | RhoMobile Suite is based on the Rhodes framework. It is a set of tools for developing data-centred, multi-platform, native mobile consumer and enterprise applications. Using RhoStudio, a free Eclipse plugin, developers can generate, develop, debug and test applications with no other hardware or emulator requirements. • RhoElements offers Object Relational Mapper enabling automatic synchronization of the backend data and even features automatic data encryption • To make offline data access available like Convertigo, RhoConnect allows developers to integrate offline data synchronisation into apps |
| 22 | SAP | As one of the older players in the market, SAP's cross-platform development offerings have grown confusing over time. However, the company set out to rationalize things last year with version 3.0 of its SAP Mobile Platform, with which cross-platform enterprise apps can be built from a single HTML5 codebase. The company has also allied itself with Cordova. "SAP made the strategic decision to heavily leverage Cordova," said SAP Senior Vice President for Mobile Development Holger Fritzinger. "This gives our customers massive benefits. They can leverage the hundreds of SAP Fiori apps—not only on mobile devices but also on the desktop—and optimize them for mobile usage with Cordova." |
| 23 | Sencha Touch | The Sencha Touch platform is an ideal choice for a cross-platform mobile app framework. The framework allows developers to build cutting-edge apps. The native looking themes are limited. The commercial licensing feature is not easy to comprehend |
| 24 | Unity 3D | This cross-platform app development tool is so popular because of its graphics quality that is absolutely incredible. It’s so easy to use this tool and you can use it for more than just a mobile app. With Unity3D tool you can export your app or games to 17 platforms that include — iOS, Android, Windows, Xbox, PlayStation, Linux, Web, and Wii. |
| 25 | Xamarin | Xamarin has made it possible for the developers to design native apps for multiple platforms using only c# code base. The tool allows developers to use the same IDE, language, and APIS everywhere. Xamarin cross-platform development has been adopted by big names like Microsoft, IBM, Foursquares and Dow Jones. If a developer wants to use ruby or C# , then it is one of the most suitable development platforms for them . Xamarin platform allows the developer to share code, which means an app can be created in less time and at decreased cost. Xamarin free version offers limited features and it does not allow a developer to use open-source libraries due to compatibility issues. |

**1.6 RESULT AND DISCUSSION OF RESULTS**

These are the merely tools but the tools requires the expert drivers to utilize the tool with its full potential. These tools are the requirements of the future for reducing similar nature of work for different devices. This is related with Green within Software computing where the process workflows are improved with this style of working.

Green software is defined in [7] as software that must fulfill three high-level requirements:

1. The required software engineering processes of software development, maintenance and disposal must save resources and reduce waste.

2. Software execution must save resources and reduce waste.

3. Software must support sustainable development. According to [6], green software is ‘an application that produces as little waste as possible during its development and operation’.

**1.7 CONCLUSION**

Green computing is discovered to be an effective and more efficient area of computing technologies. Several efforts trying to highlight the importance of including green aspects within Mobile application development have been undertaken in recent years. Our task is to raise awareness among software developers (software industries, development departments, etc.) as well as users, who hold in their hands the responsibility of choosing and demanding software that is more respectful of the environment. If we achieve this, the whole software development ecosystem will be forced to adopt greener software process.

**1.8 RECOMMENDATIONS**

We have well versed with mobile usage in today’s world. We have different mobile technologies like Native, Hybrid and Progressive app and devices like iOS, Android, Windows and many more.

Since green computing is said to have a vital effect on business work and its operations. I recommend that businesses seeking a cost-effective computing should use the tools for single-codebase cross platform to reduce power consumption and human efforts in coding the similar representation of information in different devices.

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This paper evolved from the research and development project

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sponsored by the German Federal Ministry of Education and

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Sustainable Software Blog is a private initiative of computer

scientists interested in Sustainable Informatics and Sustainable

Development. Some of them are former employees of the

GREENSOFT project.

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Sustainable Approaches and Good Practices in Green

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**1.9 Acknowledgment**

This paper evolved from the research and development done by author only. The contents of this document are the sole responsibility of the author and under no circumstances be regarding as reflecting the position of any Organization.

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