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Agile in Green Computing: An Approach towards Next Generation Computing

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Abstract—*Green computing facilitates the practices and procedures of whole life cycle of computing resources in an environment friendly way. The main objective of green computing is to minimize the adverse impact of technology on environment. The traditional software development methodologies are not so much competent to design, develop and successful implementation of green computing. In this paper we have emphasized on agile methodologies in green computing. We have also highlighted some major issues related with agile and green computing.*

Keywords*: Agile Methodology, Green Computing.*

1. INTRODUCTION

Green computing in a broader way is the practices and procedures of designing, manufacturing, using of computing resources in an environment friendly way while maintaining overall computing performance and finally disposing in a way that reduces their environmental impact[1].The traditional methodologies used in software engineering are not so much effective to manage green computing. In order to overcome the limitation of traditional software engineering methodologies Agile methodology is considered as an better approach by the professional. Agile methodology represents a group of software development methods, which use incremental and iterative development strategies in the development process. Agile methodology emphasizes on the principles of light but sufficient, being people oriented and communication centered.

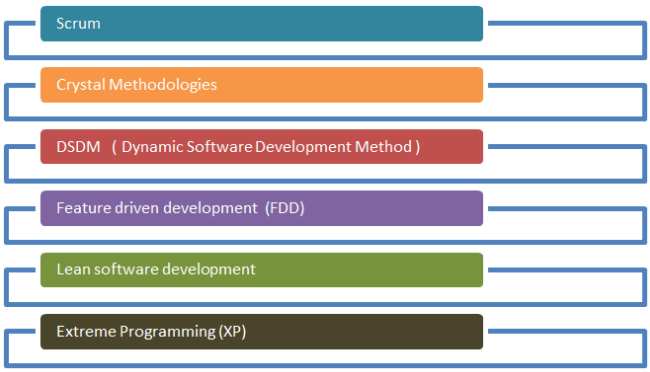
2. BACKGROUND

2.1 Agile Methodolgy

AGILE methodology is a practice that promotes **continuous iteration** of development and testing throughout the software development lifecycle of the project. Both development and testing activities activities are concurrent unlike the Waterfall model[2].

The agile software development process emphasizes on four core aspects-

1. Regular Interaction over processes and tools.
2. More importance on software over comprehensive documentation.
3. Importance on Customer collaboration.
4. Planning, Responding to change.



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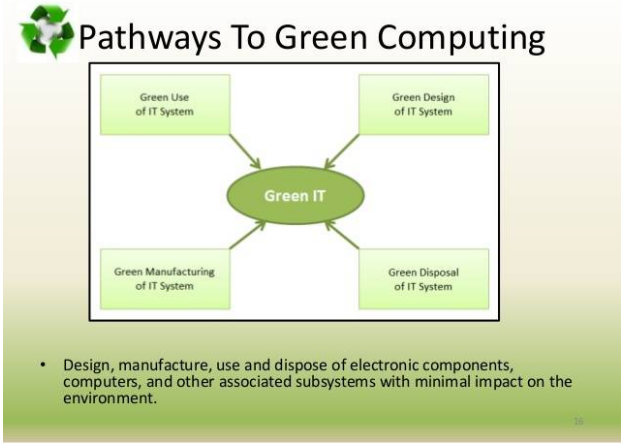
2.2 Green computing

Green computing is the environmentally responsible and eco-friendly use of computers and their resources. In broader terms, it is also defined as the study of designing, engineering, manufacturing, using and disposing of computing devices in a way that reduces their environmental impact[3]. In the IT sector manufacturers and vendors are investing in the design of energy-efficient computing devices. Their aim is to reduce the use of dangerous materials and also encouraging the recyclability of digital devices. Green computing practices came into prominence in 1992, when the Environmental Protection Agency (EPA) launched the Energy Star program[3].

Green computing is also termed as green information technology (green IT).



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3. ANALYSIS

3.1 In Agiel methodology a set of techniques are used. those are-

Scrum

SCRUM is an agile development method in which professional concentrate on how to carry out the tasks within a team-based development environment. Basically, Scrum is derived from activity that occurs during a rugby match[2]. Scrum emphasises on- empowering the development team and working in small teams.

eXtreme Programming (XP)

Extreme Programming technique is very when there is constantly changing demands or requirements from the customers or when they are not sure about the functionality of the system[2]. It advocates frequent "releases" of the product in short development cycles, which inherently improves the productivity of the system and also introduces a checkpoint where any customer requirements can be easily implemented[2].

Crystal Methodologies

Crystal Methodology is based on three concepts

1. **Chartering:** activities involved in this process are- creating a development team, preliminary feasibility analysis, developing an initial planet.
2. **Cyclic delivery:** This is the main development phase which consists of two or more delivery cycles,
3. **Wrap Up:** In this phase deployment, post- deployment reviews and reflections are executed.

Dynamic Software Development Method (DSDM)

DSDM is a Rapid Application Development (RAD) approach to software development and provides an agile project delivery framework[2]. In this technique the users are involved actively, and the teams is having the power to take decisions. The main focus of DSDS is Frequent delivery of product.

Feature Driven Development (FDD)

The focus of this method is around "designing & building" features. It includes domain walkthrough, design inspection, promote to build, code inspection and design[2].

Lean Software Development

Lean software development method is designed on the principle "Just in time production". Its aim is to increase speed of software development and decrease cost. In Lean development the phases are:-

1. Eliminating Waste
2. Amplifying learning
3. Defer commitment (deciding as late as possible)
4. Early delivery
5. Empowering the team
6. Building Integrity
7. Optimize the whole

3.2. The aim of Green computing is to attain economic viability and improving the way computing devices are used in the sector. Green IT practices include the development of environmentally sustainable production practices, energy-efficient computers and improved disposal and recycling procedures[3].

Four approaches are used in green computing:-

- **Green use:** Minimize the electricity consumption of computers and the peripheral devices and use them in an eco-friendly way.
- **Green disposal:** Proper recycling of unwanted electronic equipment
- **Green design:** It aims to design energy-efficient computers and electronic devices
- **Green-manufacturing:** The purpose is to minimize waste during the manufacturing digital devices.

4. IMPLEMENTATION

In each phase of software development life cycle the designer aim to implement green computing for less energy consumption and minimize the adverse impact on environment. In these days manufacturers are tend towards using Agiel with Green to achieve a Greener IT. It is a growing trade in subject that creates an vital need to educate next generation computer scientists or practitioners to think and achieve -green.

Now a days a good number of companies are in the process of implementation of Green. Some of the companies are[5]:-

SAP America
SAP is a world leader in enterprise software and software related services. The company uses 86,000,000 kWh of green energy annually and is committed to sustainable practices in its operations.

Sony Corporation of America
Sony is a major purchaser of green energy, utilizing more than 88 million kWh annually. This is enough power to meet roughly 37 percent of its annual energy usage.

EMC Corporation
Telecom company EMC believes that making the world a greener place is part of its corporate responsibility They've also set sustainability targets for 2020, which include reducing greenhouse gas emissions and utilizing more green energy.

Sprint
Sprint aims to reduce its overall greenhouse gas emissions by 25 percent.

Dell
Dell believes that while technology can make the world a better place, it also needs to be in line with environmental standards.

Nearly half of energy used by Dell is green at 228,262,000 kWh annually.

Cisco Systems

It is planning to reduce electricity emissions to 50 percent "Going forward," the company writes, "Cisco will continue to communicate the meaningful role that green power plays in its sustainability strategy as well as within the IT industry at large."

Apple
It utilizes 626,315,500 kWh of green power annually. It's also working to make all of its retail stores entirely sustainable, and is coming closer to that reality daily.

Google
Google is one of the biggest proponents for green energy in the world, having been a carbon neutral company since 2007. It utilizes 737,364,727 kWh of green energy annually and its data centers use roughly half the energy than a typical data center.

Microsoft
Utilizing more than 1.3 billion kWh of green power annually, Microsoft is one of the greenest companies in the world.

Intel
Intel utilizes a massive amount of renewable energy at a whopping 3,102,050,000 kWh annually. It uses energy from a number of different sources, such as solar, wind, hydro, and biomass.

Companies are also tend towards effective implementation of Agile Methodology in the place of traditional software development methods. Apart software industries, number of companies from other sector are also using Agile. Some of them are:

In marketing sector -Carsurfing, Teradata Applications, *Café Press etc*

In Construction companies are-*Noble Energy***,** *Schlumberger* etc.

Event planning companies**:**

Redgate

Product development companies:-

Wikispeed .

LEGO Digital Solutions

Finance related companies:-

Principal Financial Group, LMAX Exchange

5. CONCLUSION

Lots of researches are going on green computing for the effective implementation. Companies are alse taking step for adapting Agile. . Green computing should be implemented in software design. For this it is necessary to use greener approaches in the design of algorithms, os etc. For a sustainable development we have to adapt both green and agile in every sector.

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