RWANDA INTERNET GOVERNANCE FORUM - 2016

REPORT

13 December 2016

RWANDA UTILITIES REGULATORY AUTHORITY
Inspiring development

RWANDA ICT CHAMBER

1 Executive Summary

The 2016 Rwanda Internet Governance Forum – IGF was held on Tuesday, Dec 13, 2016. The event was held from 10:00 to 13:45 at the Gorilla Golf Hotels, in Nyarutarama, Gasabo District.
The event focused on two main topics: Software and Application development standards and Emerging technologies, the Blockchain (and crypto currencies).

The event was organized by RICTA, in partnership with RURA and the Information Communication Technology chamber of the Private Sector Federation.

The event attracted sixty-six (66) participants and representatives from various industries: from software and application, banking and financial service providers, from academia, from regulatory authority (RURA and NBR) bodies, and from the private and business sectors.

The event was organized in the form of presentations and panel discussions. This 2016 edition event was composed with the following panelists: Mr. Aimable Kimenyi, Mr. Alain Kajangwe, Mr. Regis Rugemanshuro, Mr. John Karamuka, Mr. Martin Saint, and Mr. Fiacre Mushimire. Mr. Jimmy Rutabingwa moderated the first panel, while Mr. Ghislain Nkeramugaba, RICTA CEO, moderated the second panel.

The forum was graced by the presence of Mrs. Josephine Nyiranzeyimana, the Acting Director General in the Ministry of Youth and ICT.

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3 Introduction

The purpose of the IGF is to maximize the opportunity for open and inclusive dialogue and the exchange of ideas on Internet governance (IG) related issues; create opportunities to share best practices and experiences; identify emerging issues and bring them to the attention of the relevant bodies and the general public; contribute to capacity building for Internet governance.

The Internet Governance Forum (IGF) serves to bring people together from various stakeholder groups as equals, in discussions on public policy issues relating to the Internet. While there is no negotiated outcome, the IGF informs and inspires those with policy-making power in both the public and private sectors. At this annual meeting, delegates discuss, exchange information and share good practices with each other. The IGF facilitates a common understanding of how to maximize Internet opportunities and address risks and challenges that arise. [Source: http://www.intgovforum.org/multilingual/tags/about]

The IGF Mandate

Paragraph 72 of the Tunis Agenda:
72. We ask the UN Secretary-General, in an open and inclusive process, to convene, by the second quarter of 2006, a meeting of the new forum for multi-stakeholder policy dialogue—called the Internet Governance Forum (IGF). The mandate of the Forum is to:

1. Discuss public policy issues related to key elements of Internet governance in order to foster the sustainability, robustness, security, stability and development of the Internet;
2. Facilitate discourse between bodies dealing with different cross-cutting international public policies regarding the Internet and discuss issues that do not fall within the scope of any existing body;
3. Interface with appropriate inter-governmental organizations and other institutions on matters under their purview;
4. Facilitate the exchange of information and best practices, and in this regard make full use of the expertise of the academic, scientific and technical communities;
5. Advise all stakeholders in proposing ways and means to accelerate the availability and affordability of the Internet in the developing world;
6. Strengthen and enhance the engagement of stakeholders in existing and/or future Internet governance mechanisms, particularly those from developing countries;
7. Identify emerging issues, bring them to the attention of the relevant bodies and the general public, and, where appropriate, make recommendations;
8. Contribute to capacity building for Internet governance in developing countries, drawing fully on local sources of knowledge and expertise;
9. Promote and assess, on an ongoing basis, the embodiment of WSIS principles in Internet governance processes;
10. Discuss, inter alia, issues relating to critical Internet resources;
11. Help to find solutions to the issues arising from the use and misuse of the Internet, of particular concern to everyday users;
12. Publish its proceedings

4 Purpose & Objectives of the Forum

"**The Internet, an evolving ecosystem**" was the theme of this year's (2016) Rwanda IGF.

The focus of this year's forum was on two main subjects or topics: a discussion on Software and Application development standards and another on emerging technologies, the Blockchain and crypto currencies, the technology behind Bitcoin, its technology, regulatory aspects and business perspectives.

Topic-1: Steps towards establishing Software Application Development Standards

We live in a digital world where software and applications are at the center of our lives: cars, transport systems, home appliances, services industry, trading, social life (social networks), etc. There are less and less "things" that are not controlled by software or applications.

Considering the increasing dependence on software and application, it is critical and vital to ensure that that software and applications follow rigorous standards to ensure effective use and security.

Topic-2: Emerging technologies, the Blockchain (and the Cryptocurrencies)

The Bitcoin is what is called a cryptocurrency, which is based on a technology called Blockchain. We have seen a lot of development in that perspective, and the 2016 edition of the Rwanda IGF intends to start a discussion about these new technologies.

The discussions were to revolve around the technology itself, the regulatory aspects and the business perspective. The objective of this topic was to raise the awareness of the participants all about this relatively new technology and assess what are the opportunities that lay behind such technologies.

5 Outcomes and recommendations from the Forum

5.1 Introduction

5.1.1 Software and Application development Standards

To start discussing the matter, a presentation, by Mr. Regis Rugemanshuro, CEO of BK Telecom, was given to the participants. His focus was put on the developers. He stated that Software and application development characteristics should not be far from craftsmanship. Such characteristics are forged in the developer's character throughout continuous education and improvement. The detailed presentation is attached in **Appendix-1.**

On the same topic, a panel, moderated by Mr. Jimmy Rutabingwa, and composed of Mr. Alain Kajangwe, Mr. Kimenyi Aimable and Mr Regis Rugemanshuro, who had just made a presentation, engaged with the participants about the subject matter. The detailed biographies of all the panelists can be found in **Appendix-2.**

5.1.2 Emerging Technologies, The Blockchain (and the crypto currencies)

For the second session on “Emerging technologies, the Blockchain (and the Cryptocurrencies)”, there was two presentations, the first presentation was done by Mr. Martin Saint, a lecturer at Carnegie Mellon University (CMU), who talked about the basics of the Blockchain technology.
He stated that the Blockchain is a distributed and shared digital ledger that works on a fully peer-to-peer network, which can either be a public or private network. The Blockchain integrity is purely based on cryptography, which validates and chains together blocks of transactions together.

Mr. Martin gave as well a list of potential areas, industries, and sectors of activities where the Blockchain technology can be used. His entire presentation “**Blockchain Overview**” is contained in **Appendix-3.**

Mr. Karamuka John, Director of Payment Systems in the National Bank of Rwanda gave the second presentation about Blockchain. He emphasized more on the regulatory aspects and shared with the audience about some countries, which are implementing some pilot and tests. His entire presentation "**Blockchain, Distributed Ledgers and Digital Currency**” is contained in **Appendix-4.**

5.2 Outcomes and Recommendations

The following were the outcomes and recommendations:

1. In order to raise the standards of software and application development, a strong, specific and continuous focus should be put on the developers themselves. The developers are at the center of a successful software and application development industry. It was recommended that Software & Application developers abide by the best current practice in regards to software development, and adhere to standards such as agile application development standards among others. The latter is particularly important and crucial since Rwanda is eyeing to become a Business Processing Outsourcing (BPO) destination, which could develop software and application for the rest of the world.
2. About Software certification: It is a heated debate in this current era: **Should it be the norm that software & Application developers be certified**? The audience warned about such move (i.e. software certification), which could hinder or slow down innovation.
    a. It was recommended that no software certification be imposed on software and application developers, or imposed on software and application apart from the known international standards such as Agile software management, and/or others.
    b. The establishment of a third-party entity/organization to "certify" all software in Rwanda would be practically impossible and would hinder innovation and introduce delays in project implementations.
3. About consumer protection: Imposing software certification and/or adhering to software best current practices by the software developers were two of the main ideas the audience debated on in order to improve and ensure consumer protection. However,

imposing software certification was widely discouraged. Nonetheless, software and application developers should know they play a critical role in protection the consumers.

4. About self-regulation in the software and application development sector: It was recommended that measures and procedures be put in place by the Private Sector Federation (PSF) / ICT Chamber to ensure that guidelines are established to ensure high standards in software and application development.
5. About emerging technologies, Blockchain: It was recommended that more discussions in the academia, banking/financial sectors be held to assess and explore the benefits these new technologies bring.

6 APPENDIX-1

6.1 “Software Craftsmanship”

By Mr. Regis Rugemanshuro

INTERNET GOVERNANCE FORUM 2016

Theme: "The internet, an evolving ecosystem"

SOFTWARE CRAFTSMANSHIP

TRANSFORMATIONAL TECHNIQUES FOR BUILDING ENGINEER AND ARCHITECT EXCELLENCE

PRESENTED BY REGIS RUGEMANSHURO, PMP, SPC4

BK TELECOM LTD - CEO

AGENDA

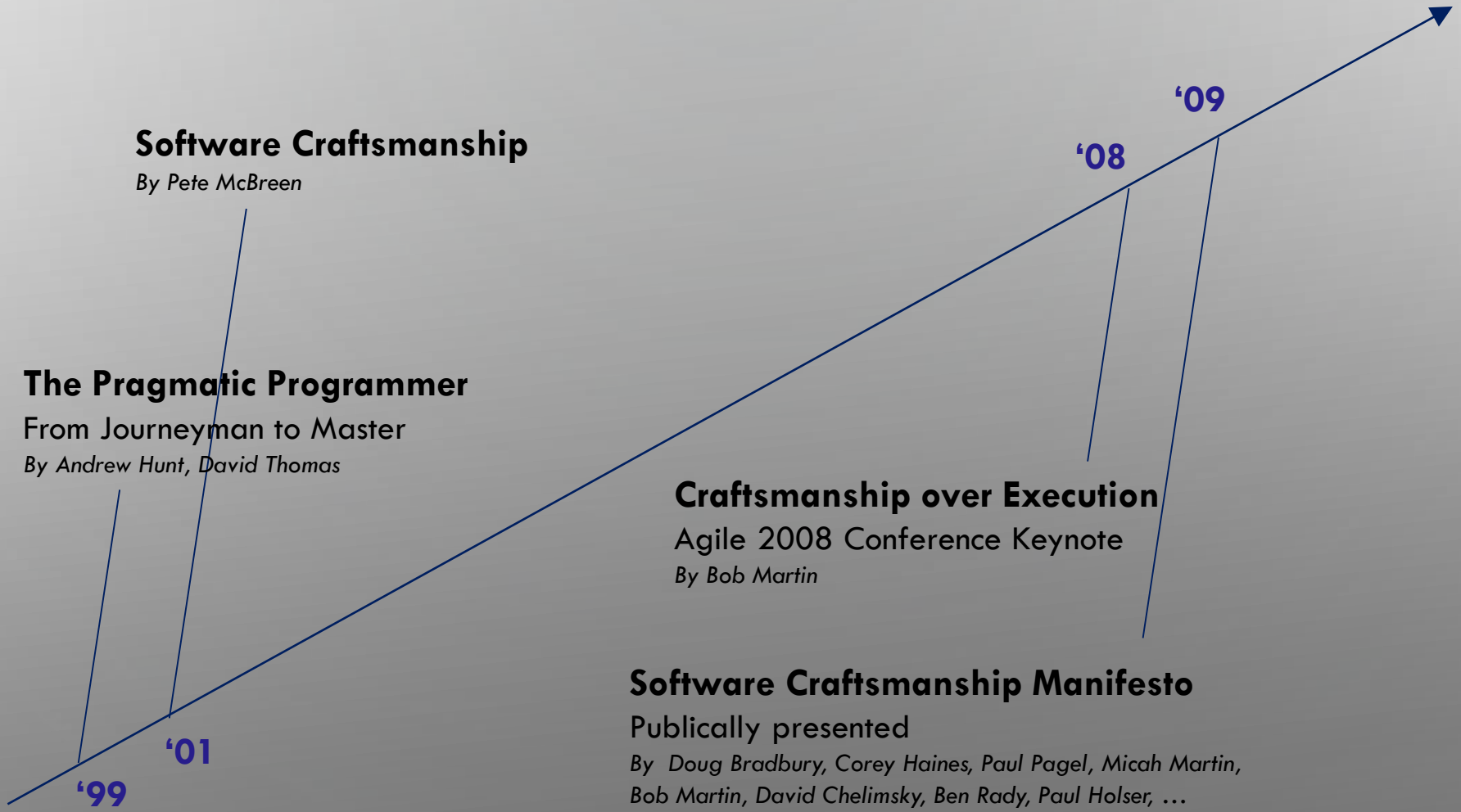
- What is Software Craftsmanship?
- Why do we need it?
- What makes for a Software Craftsmanship culture?
- Supplementary information

What is it?

WHAT IS SOFTWARE CRAFTSMANSHIP?

"An approach to software development that emphasizes the coding skills of the developers themselves."

WHAT IS SOFTWARE CRAFTSMANSHIP?



The Pragmatic Programmer
From Journeyman to Master
By Andrew Hunt, David Thomas

Software Craftsmanship
By Pete McBreen

Craftsmanship over Execution
Agile 2008 Conference Keynote
By Bob Martin

Software Craftsmanship Manifesto
Publically presented
By Doug Bradbury, Corey Haines, Paul Pagel, Micah Martin, Bob Martin, David Chelimsky, Ben Rady, Paul Holser, …

WHAT IS SOFTWARE CRAFTSMANSHIP?

agilemanifesto.org

Agile Manifesto

We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

Working software,
over comprehensive documentation

Responding to change,
over following a plan

Individuals and interactions,
over processes and tools

Customer collaboration,
over contract negotiation

manifesto.softwarecraftsmanship.org

Manifesto for Software Craftsmanship

As aspiring Software Craftsmen we are raising the bar of professional software development by practicing it and helping others learn the craft. Through this work we have come to value:

AN EXTENSION OF THE AGILE MANIFESTO

Not only working software,
but also well-crafted software

Not only responding to change,
but also steadily adding value

Not only individuals and interactions,
but also a community of professionals

Not only customer collaboration,
but also productive partnerships

That is, while there is value in the items on the right, we value the items on the left more.

WHAT IS SOFTWARE CRAFTSMANSHIP?

Software development

2 parts science, 1 part art

WHAT IS SOFTWARE CRAFTSMANSHIP?

A highly creative practice

Many can do it

Few do it well

WHAT IS SOFTWARE CRAFTSMANSHIP?

Software Craftsmanship drives for…

Quality built in

Long-term sustainability

Performance

Security

Community of practice

Passion for the work

Engineering excellence

WHAT IS SOFTWARE CRAFTSMANSHIP?

It achieves this through…

Apprenticeship

Peer-to-peer training

Code review practices

Empowering individuals

Skills focus

Community of professionals

Why do we need it ?

WHY DO WE NEED SOFTWARE CRAFTSMANSHIP?

Some Business-Value Mathematics

WHY DO WE NEED SOFTWARE CRAFTSMANSHIP?

Time pressure + Lack of Training + Poor Motivation

||

Poor Code

Writing Clean Code, IBM developerWorks
by Professor Gary Pollice, Worcester Polytechnic Institute

WHY DO WE NEED SOFTWARE CRAFTSMANSHIP?

Poor Code + Time

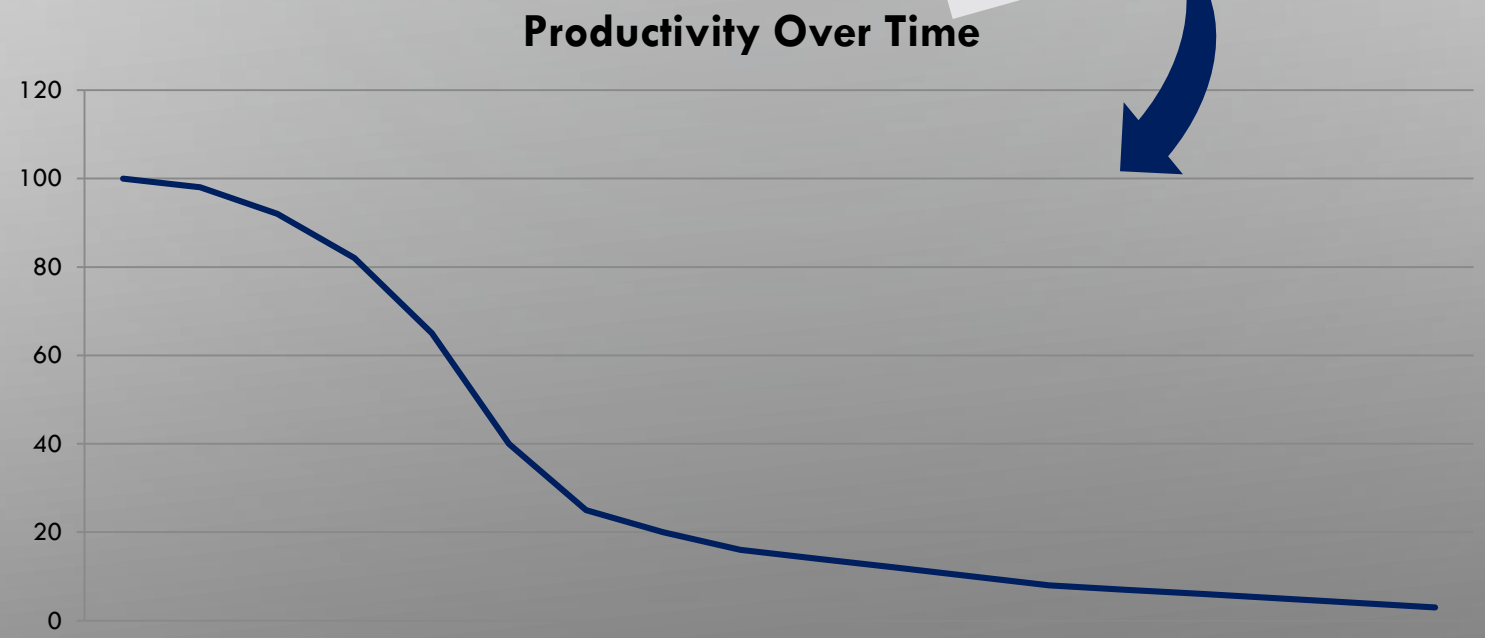
||

Massive Productivity Loss

Clean Code: A Handbook of Agile Software Craftsmanship by Robert C. Martin and Object Mentor Inc.

WHY DO WE NEED SOFTWARE CRAFTSMANSHIP?

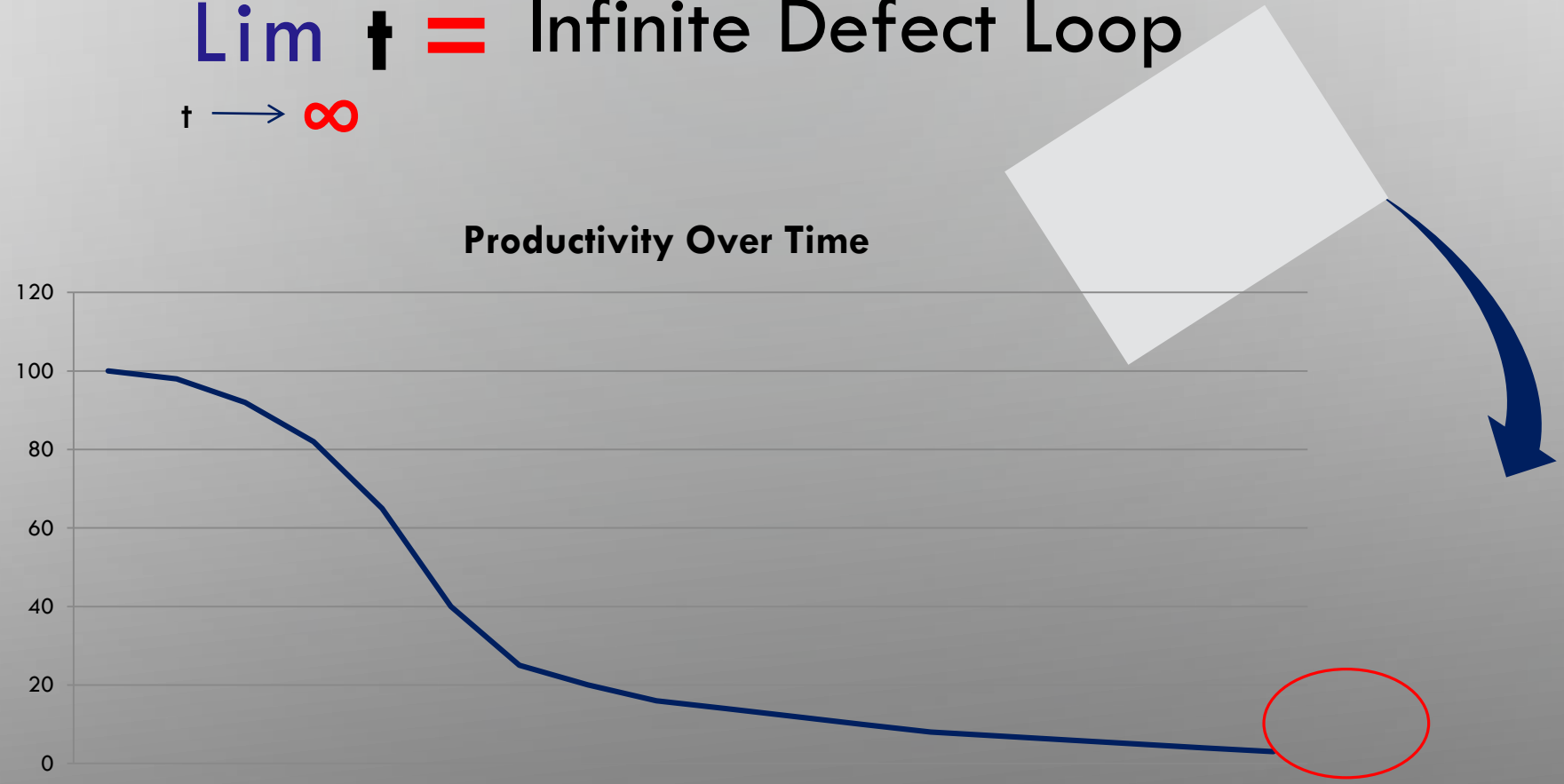
Poor Code + Time = *Massive Productivity Loss*



Clean Code: A Handbook of Agile Software Craftsmanship by Robert C. Martin and Object Mentor Inc.

WHY DO WE NEED SOFTWARE CRAFTSMANSHIP?

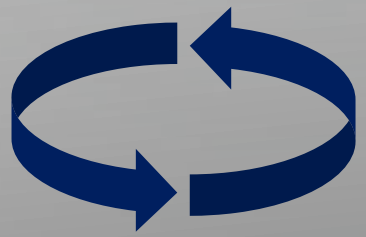
$$\lim_{t \to \infty} t = \text{Infinite Defect Loop}$$



The Business of Software: What Every Manager, Programmer and Entrepreneur Must Know to Thrive and Survive in Good Times and Bad by Michael A. Cusumano by Free Press March 2004

WHY DO WE NEED SOFTWARE CRAFTSMANSHIP?

Infinite Defect Loop: A critical point in the degradation of code quality at which point productivity is nearly 0. With each code fix several other bugs are introduced.



The Business of Software: What Every Manager, Programmer and Entrepreneur Must Know to Thrive and Survive in Good Times and Bad by Michael A. Cusumano by Free Press March 2004

WHY DO WE NEED SOFTWARE CRAFTSMANSHIP?

Why else do we need it?

WHY DO WE NEED SOFTWARE CRAFTSMANSHIP?

Leading to a progression of benefits

WHY DO WE NEED SOFTWARE CRAFTSMANSHIP?

Progressive Benefits

Effective training & skill development

Harness our great people

Client satisfaction

Job satisfaction

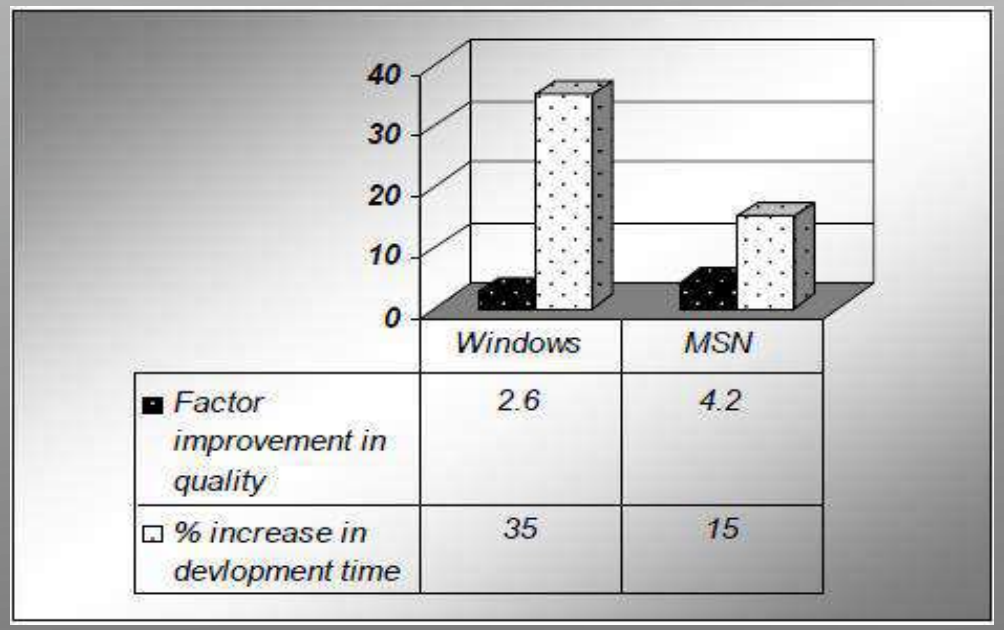
And so much more…

WHY DO WE NEED SOFTWARE CRAFTSMANSHIP?

From the research community:

"[While the use of] TDD took extra time upfront the resulting quality was higher…by an order of at least two times." - **Evaluating the Efficacy of Test-Driven Development: Industrial Case Studies – *Microsoft Research***

Craftsmanship practices can significantly improve quality with relatively small investment.



WHY DO WE NEED SOFTWARE CRAFTSMANSHIP?

From the research community:

"[T]he data from this data-site do not support the hypothesis that achieving high productivity or quality requires sacrificing the other." - **Factors affecting software maintenance productivity: An exploratory study – Carnegie Mellon & MIT**

Quality and productivity are not mutually exclusive, even in the short term

WHY DO WE NEED SOFTWARE CRAFTSMANSHIP?

From the research community:

"TDD teams realized a significant decrease in defects, from 62% to 91%." - **On the Effectiveness of Unit Test Automation at Microsoft – Microsoft**

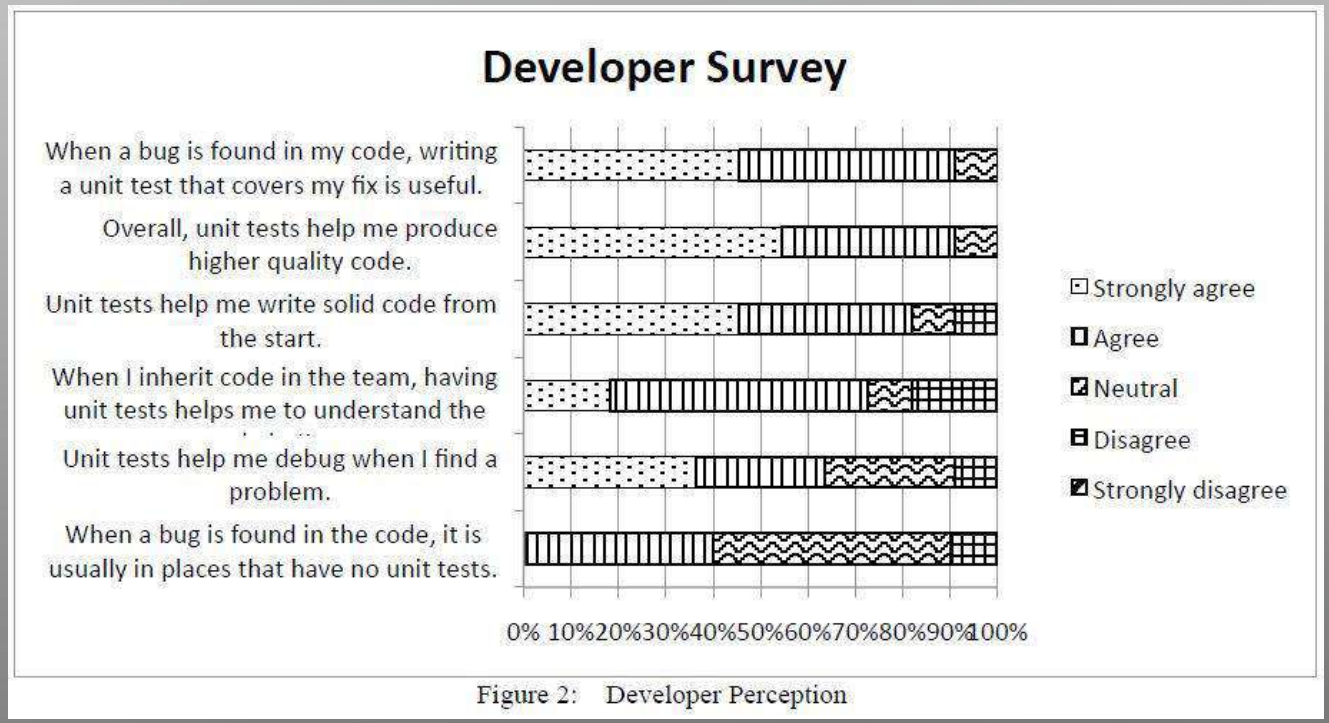


Figure 2: Developer Perception

How do we get it ?

WHAT MAKES FOR A SOFTWARE CRAFTSMANSHIP CULTURE?

As with Agile, we focus on principles/patterns:

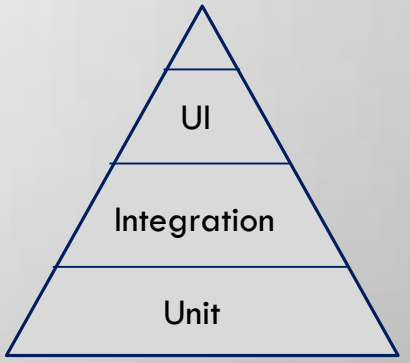
5 key principles*:

1. Leadership support and buy-in
   - Some steps are scary & require dedication
   - You can't sell what you wouldn't buy
   - It is all about passion for the craft
2. One or more champions
   - Leadership buy-in isn't enough
   - Champions = passionate craftsmen
   - Champions must have time to evangelize
   - Cutting quality corners is endemic in software development & requires great diligence to cure
3. Skill identity and community
   - It can't all be about delivery and projects
   - Engineers & Architects must be clearly identified & have close ties to a skills leadership group
   - The skills group should have a strong social community
4. An atmosphere of autonomy and freedom
   - Craftsman must have sufficient opportunities to learn from their choices
   - Autonomy with oversight, not prescriptive management
   - Craftsman must be empowered to decide when the code is clean enough
5. An atmosphere of continuous improvement and learning
   - Agile and iterative are critical to craftsmanship
   - Goals/targets should encourage continuous improvement of the overall solution
   - Learning & sharing of ideas should be institutionalized

WHAT MAKES FOR A SOFTWARE CRAFTSMANSHIP CULTURE?

Craftsmanship Culture Design Patterns

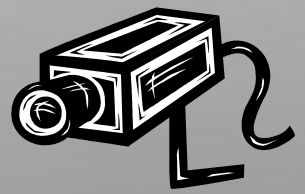
WHAT MAKES FOR A SOFTWARE CRAFTSMANSHIP CULTURE?



- **Testing Triangle**

- **Apprenticeship**

- **Geeks are Cool**



- **Big Brother**

- **King of the Skill**

- **Craft Codex**

* Every Worker Is a Knowledge Worker

** Time Pressure and Creativity: Why Time is Not on Your Side

WHAT MAKES FOR A SOFTWARE CRAFTSMANSHIP CULTURE?

- Happy Hour

- Magnifying glass

- Ivy League

- Program Council

- Counter-balance

- Daily Code Reviews

- It Takes a Village

Clean Code: A Handbook of Agile Software Craftsmanship by Robert C. Martin and Object Mentor Inc.

Supplementary information

WHAT IS SOFTWARE CRAFTSMANSHIP?

Supplemental studies

- The Pragmatic Programmer: From Journeyman to Master *By Andrew Hunt, David Thomas*
- Software Craftsmanship *By Pete McBreen*
- Apprenticeship Patterns : Guidance for the Aspiring Software Craftsman *By Dave Hoover, Adewale Oshineye and O'Reilly Media publishing*
- The Business of Software: What Every Manager, Programmer and Entrepreneur Must Know to Thrive and Survive in Good Times and Bad *By Michael A. Cusumano by Free Press March 2004*
- Clean Code: A Handbook of Agile Software Craftsmanship *By Robert C. Martin and Object Mentor Inc.*
- *Software Craftsmanship - Building excellence in software development teams by Michael Dwyer, Accenture*
- Writing Clean Code, IBM developerWorks http://www.ibm.com/developerworks/rational/library/nov06/pollice/index.html *By Professor Gary Pollice, Worcester Polytechnic Institute*
- Programming is not a craft http://dannorth.net/2011/01/11/programming-is-not-a-craft/ *Blog by Dan North*
- Webcasts from CleanCoders.com http://www.cleancoders.com/

Thanks!

7 APPENDIX-2

7.1 Table-1: Software and Application development standards Panel

Names	Biography
Moderator of the Session: **Mr. Jimmy Rutabingwa, Founder and MD of IMAGINET Ltd.**	Mr. Jimmy Rutabingwa is the founder and Managing director of IMAGINET Ltd. an IT company founded and Incorporated in 2003 by a group of young business and technical professionals. IMAGINET Ltd. offers a wide range of services, which includes FinTech, Web and E-mail services, among others. Jimmy has been contributing in developing the local IT community, participating in several national events, and initiatives to promote IT in Rwanda, and in the East Africa region.
Mr. Kajangwe Alain **(A Software and application developer)**	Alain Kajangwe is the Founder and CEO of WiredIn Ltd. a Rwandan registered company offering offshore software development services to clients in Japan and Europe. WiredIn currently offers software development services in Web and Mobile application development (iOS and Android platforms). Alain is, also, currently working with Pivot Access Ltd. as a senior software developer, on systems integration with various financial institutions in Rwanda. Previous work experience includes work at XCOM AG, in Willich, Germany, as a senior software developer and project manager. Other work experience includes work as a BASE24-eps system administrator at SIMTEL SARL from July 2005 to July 2008. Alain also worked as an Airworthiness Inspector for Flight Operations at the Rwanda Aviation Authority from July 2004 – July 2005. Alain holds a Master's of Science degree in IT/Mobility Track from Carnegie Mellon University (2008 - 2010) and a Bachelor of Science degree in Computer Science from La Roche College (2001 - 2004).
Mr. **Aimable Kimenyi** **(Chair of the Software association in the ICT chamber/PSF)**	Kimenyi is CEO of Algorithm Inc. A management software company known as Ishyiga software market leader in managing pharmacies in Rwanda and Burundi, now operating in 5 countries, he is also President of Rwandan Software association in PSF since 2014.
Mr. **Regis Rugemanshuro, MBA, PMP, SPC4**	Regis is the current acting CEO of BK Telecom Ltd, a start-up Technology Company by Bank of Kigali. Prior to this, he spent his career in the United States consulting for the global Tech Giants such as Hewlett-Packard (HP) as a Program Manager and later with Accenture PLC in Seattle, Washington. During his time there, his main clients included Microsoft and T-Mobile. His area of focus is at the intersection of Business and Technology; his expertise is in helping clients realize the promise of the digital revolution via adoption of modern engineering platforms and practices. Regis has a Bachelor degree in Science Information Technologies and an MBA in Management both from Misericordia University in Pennsylvania. He is also a Certified Project Management Professional (PMP) from the Global Project Management Institute (PMI) as well as a Certified SAFE

	Program Consultant (SPC4) from the Global Scaled Agile Academy.

7.2 Table-2: Emerging Technologies, The Blockchain Panel

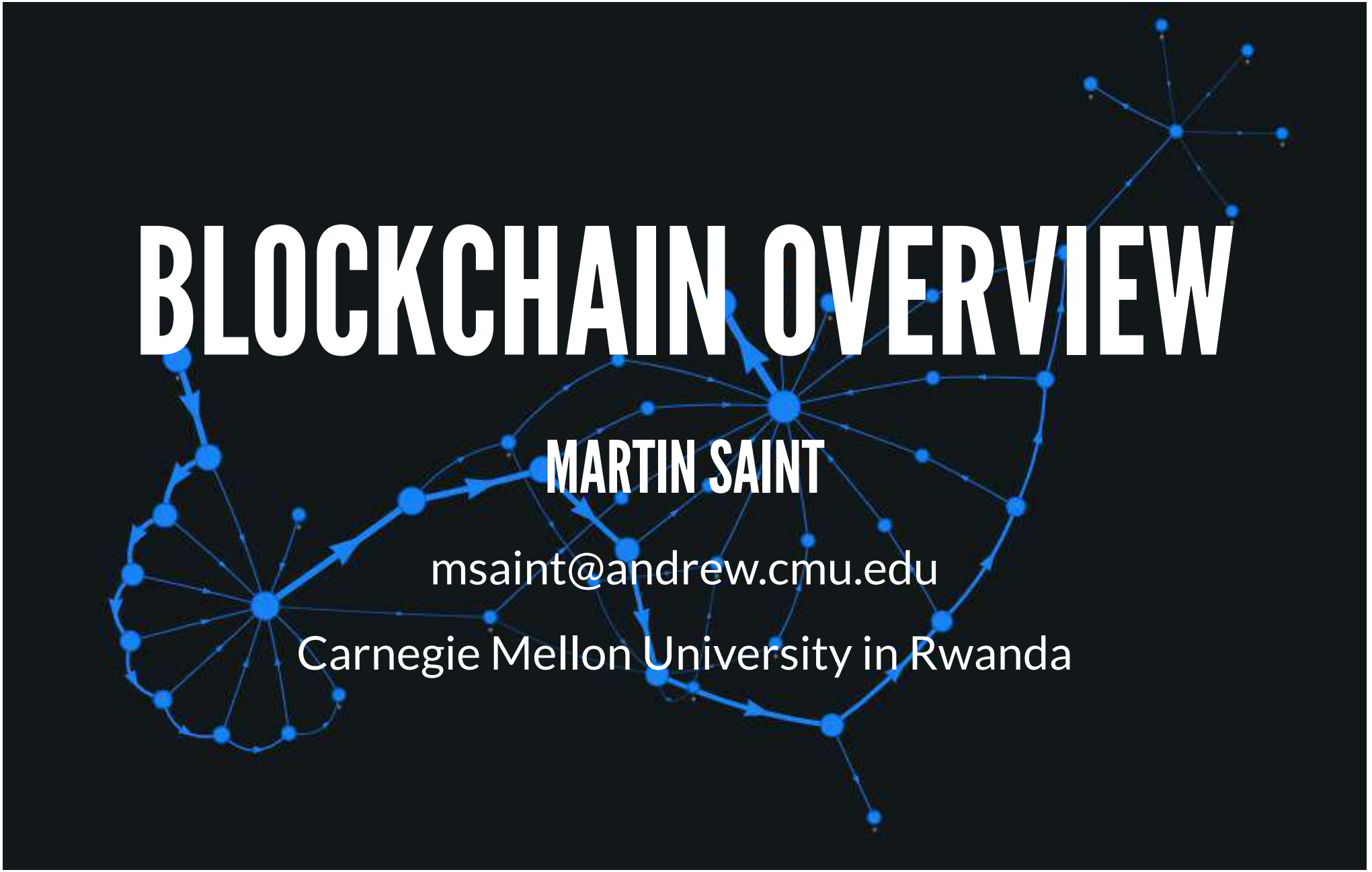
Names	Biography
Moderator: **Mr. Nkeramugaba Ghislain, CEO of RICTA Ltd.**	Ghislain joined Rwanda Information and Communication Technology association (RICTA) in November 2011, He is currently the Chief Executive Officer, and Ghislain received his undergraduate degree from the Kigali Institute of Science and Technology (KIST) in Computer Engineering and Information Technology (CE&IT) and holds a Masters Degree in Communications Management (MCM).
Mr. **John** **Karamuka** **Director of Payment Systems Department at the National Bank of Rwanda**	Karamuka Bagirishya John is Director of Payment Systems Department at the National Bank of Rwanda since July 2011. He has been working in payment systems since 2007. He contributed significantly to the development of the payment system in Rwanda including the establishment of the Rwanda Payment Processing System and the legal framework reform undertaken since 2009.
Mr. **Regis Rugemanshuro, MBA, PMP, SPC4, CEO of BK Telecom Ltd.**	Regis is the current acting CEO of BK Telecom Ltd, a start-up Technology Company by Bank of Kigali. Prior to this, he spent his career in the United States consulting for the global Tech Giants such as Hewlett-Packard (HP) as a Program Manager and later with Accenture PLC in Seattle, Washington. During his time there, his main clients included Microsoft and T-Mobile. His area of focus is at the intersection of Business and Technology; his expertise is in helping clients realize the promise of the digital revolution via adoption of modern engineering platforms and practices. Mr. Regis has a Bachelor degree in Science Information Technologies and an MBA in Management both from Misericordia University in Pennsylvania. He is also a Certified Project Management Professional (PMP) from the Global Project Management Institute (PMI) as well as a Certified SAFE Program Consultant (SPC4) from the Global Scaled Agile Academy.
Mr. Saint Martin, Scholar-in-Residence, Carnegie Mellon University, Rwanda Campus	Martin Saint is a Scholar in Residence at Carnegie Mellon University in Rwanda. His background includes network and telecommunications engineering, creating and managing facilities and infrastructure for datacenter and telecommunications clients, work in emergency planning and response, and corporate business management. He currently teaches and researches in the areas of telecommunications, network engineering, cyber-physical systems, financial technology, and digital financial services. Martin has an MS and Ph.D. candidacy from the Interdisciplinary Telecommunications Program at the University of Colorado. He has worked with the U.S. Federal Emergency Management Agency's

	Emergency Management Institute, the International Centre for Theoretical Physics in Italy, and Idaho National Laboratory, home to the U.S. Department of Homeland Security's (DHS) Control System Security Program and the Industrial Control Systems Cyber Emergency Response Team. He is a member of the DHS Industrial Control Systems Joint Working Group (ICSJWG), the Internet Society (ISOC) Internet Engineering Task Force (IETF), the Institute of Electrical and Electronic Engineers (IEEE), and the Association for Computing Machinery (ACM).
Mr. Fiacre Mushimire **Emerging communication technology analyst, Rwanda Utilities and Regulatory**	Fiacre MUSHIMIRE is a software engineer with more than 8 years of experience developing the web and mobile applications. He is also an avid cyber-security and open-source evangelist, having funded the Rwanda Open Source Community and actively contributed in many open-source focused applications such as the Kumva [www.kinyarwanda.net] English-Kinyarwanda dictionary and the e-Umuganda [http://goo.gl/keInTA] initiative. Fiacre also holds an MSc in information technology from the prestigious university Carnegie Mellon. Apart from software engineering related activities, Fiacre is also an avid entrepreneur. He's currently working for RURA as their emerging communication technology analyst. Fiacre, in short, describes himself as a person with willingness to learn, good interpersonal relationship skills, responsible, creative, organized, interested in professional development, interested in information security and with extensive experience in the field of information technology.

8 APPENDIX-3

8.1 “Blockchain Overview”

BLOCKCHAIN OVERVIEW



MARTIN SAINT

msaint@andrew.cmu.edu

Carnegie Mellon University in Rwanda

TOPICS

What is the blockchain?
Why is it hard to understand?
What is a cryptocurrency?
How does the blockchain work?
What is mining?
Why the current interest?
What does blockchain enable?
The potential impact
Unknowns

WHAT IS THE BLOCKCHAIN?

A distributed transaction ledger.

WHY IS BLOCKCHAIN HARD TO UNDERSTAND?

MANY ELEMENTS:

Computers
Database
Software
Clients
Cryptography
Game theory
Computer networking and data transmission
Economic and monetary theory
Culture
No central control or authority

WHAT IS A CRYPTOCURRENCY?

A digital asset, tracked by the blockchain

HOW DOES IT WORK?

SIMPLE VIEW

Download a wallet application

Transfer Bitcoin to a public key address

Transaction is confirmed and posted to the blockchain

A MORE DETAILED VIEW

1.

Two parties agree to a transaction

Could be Bitcoin, another cryptocurrency , a contract, a record, or any type of digital asset.

2.

The transaction details are broadcast to a peer-to-peer network of computer nodes running blockchain software.

3.

Each computer node runs an algorithm to validate the transaction.

4.

When the transaction is validated, it is combined with other transactions to create a "block" of data for the ledger.

5.

The new block is added to the chain of blocks, thus it is called a blockchain.

The record of the transaction is permanent and cannot be altered.

6.

Transaction complete.

WHAT IS MINING?

Miners perform the work required for validation, and receive a payment.

WHY SO MUCH INTEREST IN THE BLOCKCHAIN?

In the same way that billions of people around the world are currently connected to the World Wide Web, billions of people may soon be connected to blockchains.

WHAT ARE BENEFITS OF THE BLOCKCHAIN?

Transparency
Accuracy
Permanent record
Low cost
Global
Distributed/redundant/fault-tolerant
No need for trusted intermediary or central authority
Low barriers to use (device and Internet connection)
Corruption resistance

EXAMPLE APPLICATIONS

FINANCIAL SERVICES

The blockchain is an exchange network for moving transactions, value, and assets between peers without the assistance of intermediaries.

The blockchain validates transactions, replacing middlemen and trusted central authorities.

Faster, cheaper transactions and settlement.

HEALTHCARE

Patient information can be securely encrypted and shared with multiple providers.

VOTING

Votes could be cast via a smartphone or computer. Results are verifiable and immediately available.

DOMAIN NAMES

The top level domain .bit is managed by Namecoin via a blockchain based registry.

UNKNOWNS

Complex technology
Challenges to implementation
Regulatory implications
Competing platforms
Loss of control by governments and banks
May enable new forms of crime and corruption

SUMMARY

What is the blockchain?
Why is it hard to understand?
What is a cryptocurrency?
How does the blockchain work?
What is mining?
Why the current interest?
What does blockchain enable?
The potential impact
Unknowns

9 APPENDIX-4

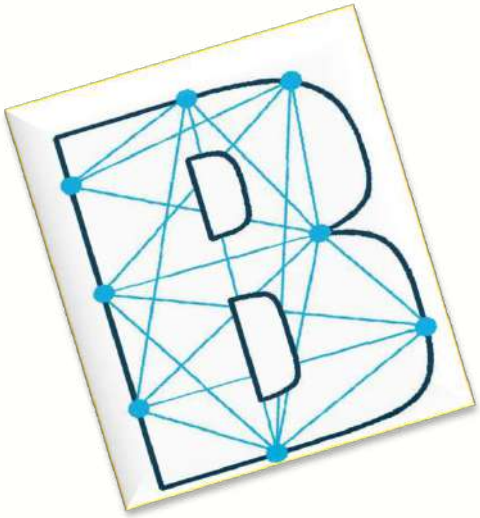
9.1 “Blockchain, Distributed Ledgers and Digital Currency”

NATIONAL BANK OF RWANDA

Blockchain, Distributed Ledgers and Digital Currency

Outlines

- Introduction: FinTech Landscape
- Key features and benefits
- Concern over digital currency
- Regulatory actions
- Way forward



Introduction

- New technologies are driving transformational changes in the global economy, including in how goods, services, and assets are exchanged.
- Disruptive Forces in Financial services are observed among others in the following domains:

- Digital and mobile payment;
- **Blockchain and Distributed Ledgers, Bitcoin and Criptocurrencies (**Bitcoin and alcoins like XRP, Litecoin**);**
- Big data analysis;
- Crowdfunding and peer to peer lending;
- Personal finance management;

Introduction

- DCs fall within the broader category of digital money like e-money;
- DC schemes comprise two key elements:

i. the "**currency**" that can be transferred between parties denominated in **their own unit of account**. ; and

ii. the underlying "**payment and settlement**" mechanisms, including the distributed ledger system

Key features and uses of digital currencies

1. As Value (non physical money)

- DCs are assets as opposed to e-money and value is determined by supply and demand (gold but with no intrinsic value)
- are denominated in their own units of value
- not a liability of any individual nor are they backed by any authority
- value relies only on the belief that they might be exchanged for other goods or services
- typically determined by a computer protocol (blockchain)
- The supply is determined by an algorithm and rules that help to create scarcity

Key features and uses of digital currencies

2. The payment system: way in which value is transferred from a payer to a payee

- Use of **distributed ledgers to allow** remote peer-to-peer exchanges of e-value without intermediary
- cryptographic keys that give him/her access to the value
- confirmation process that validates the transaction (mining)
- adds it to a unified ledger of which many copies are distributed

3. institutional arrangements.

- No identifiable scheme operator
- intermediaries, however, that supply various technical services such Payment system, foreign exchanges.

Key benefits

- **Transparency**: all transactions are publicly available and verifiable in the electronic ledger called the blockchain
- **Security**: cryptographic keys
- **Lower transaction costs**: (average cost of 1%) compared to other payment methods like Paypal and WU.
- **Anonymity**: an encrypted wallet can be spent without identification
- **Resilience**: because of decentralized nature, it is resilient to attacks;
- **Engine for innovation**: Blockchain and DLT can be used for more service (smart contract, etc, ….)

Digital currency limitation

- **VCs pose a definitional challenge to regulators:** (properties of currencies, commodities, and payments systems)
- **The transnational reach of VCs complicates regulation:** the borderless online nature of digital currencies
- **Their decentralized nature does not fit easily within traditional regulatory models**. Through the use of distributed ledger technologies. the absence of an identifiable "issuer" of the instrument

Digital currency limitation

- **Financial Integrity (AML/CFT):** The anonymity and cross-border reach of VCs raise genuine concerns from a financial integrity standpoint;
- **Consumer protection:**

- Risks related to unregulated VC intermediaries and service providers,
- Digital currencies is used as means of speculation;
- Risks related to scams (cheating consumers with fake opportunities) (e.g. onecoin which operate like a pyramid)
- Risks related to the irreversibility of transactions

Digital currency limitation

- **Financial Stability:**

✓ VCs do not pose systemic risks to financial stability, due to small scale and limited linkages to the financial system.

✓ VCs may pose financial risks to individual VC holders and users (bankruptcy of the main Bitcoin exchange platform (Mt. Gox) resulted into a loss of 850,000 btc= $450 million.).

Digital currency limitation

- **Monetary Policy:** VCs with rigid supply rules, 3 monetary stability risks:

- the risk of structural “deflation” (gold standard regime);
- flexibility to respond to temporary shocks to money demand;
- the capacity to function as a lender of last resort (in case Emergence liquidity)

Regulatory actions

- **Regulators have begun to address these challenges, with a variety of approaches across countries. Responses have included:**

- clarifying the applicability of existing legislation to DCs,
- Issuing warnings to consumers,
- Imposing licensing requirements on certain DC market participants,
- Prohibiting financial institutions from dealing in DCs, completely banning the use of DCs, and prosecuting violators.

Regulatory actions

Main options	Type of actions / Country examples
Information/ moral suasion	Public warnings, Investor/buyer information, Research papers
Specific stakeholder regulation	➢ Digital currency administrators (record-keeping, reporting, AML/ TF). *E.g. United States.* ➢ Digital currency exchangers (record-keeping, reporting, prudential measures, AML/TF). *E.g: United States, France, Canada, Singapore, Sweden.* ➢ Consumer protection measures (payment guarantee, redeemability etc).

Regulatory actions

of actions / Country examples	Type of actions / Country examples
Interpretation of existing regulations	➢ Application of regulation based on “interpretation” of how existing framework (eg tax law treatment) may be applied to digital currencies or digital currency intermediaries. *Example: United States*.
Prohibition	➢ Ban (or amount cap) on retail Bitcoin transactions ➢ Ban on digital currency acceptance by retailers. ➢ Ban on digital currency-based financial instruments. *Examples: China, Belgium.* ➢ Ban on digital currency exchangers. ➢ Ban on Bitcoin transactions between banks. *Examples: China, Mexico*

Relevancy to the Central Bank

- central banks' role in the payment system ;
- supervisory responsibilities for institutions that may provide digital currency services ;
- conduct of monetary policy ;
- issuance of legal currency and legal tender;
- their role in maintaining financial stability

Potential issuance of digital currency by central banks

- Issuance of digital currency through the permissible ledger:
- Singapore
- Canada is experimenting a digital fiat called CAD-COIN
- Denmark, Sweeden and Britain
- Senegal has declared to start issuing (e-CFA)
- Central bank Ecuador is issuing money again

Conclusion and Way forward

- Currently there is not an enabling legal framework for digital currency in Rwanda;
- BNR is monitoring the manner in which DCs are evolving and the policy challenges they may pose;
- The BNR position over the digital currencies and educate the population is needed;
- Exploit the possibility of using the '**distributed ledger**' technology as an innovation in finance technology;
- Create an enabling regulatory framework for testing (Sandbox) to support innovative products.
- to support the research, development and application of new technology, to promote competition and innovation.

THANK YOU