UNIVERSITY OF NICOSIA
ΠΑΝΕΠΙΣΤΗΜΙΟ ΛΕΥΚΩΣΙΑΣ

DFIN-511
Introduction to Digital Currencies

Session 11
Digital Currency and Innovation

Objectives of Session 11

- Understand the core principles of innovation at an introductory level
- Understand the impact of innovation in today's world and gain a better perspective though the introduction of models and frameworks
- Apply the concepts of innovation to the development of Bitcoin and Digital currencies

Agenda

- Innovation - Basic Principles
- Diffusion of innovation
- Why Bitcoin is an innovation
- Creating space for more Innovation
- Conclusions
- Self-Assessment Exercises and Further Reading

Innovation - Basic Principles

What is innovation?

- ***"Innovation is the creation of a new viable offering"*** **(Keely, L. et al, 2013)**
  - Innovation, not invention, has to create and return value
  - By new offerings one should think beyond products
- The determinants for creativity and innovation include people/culture, resources, capabilities and processes in an organization, systems and structure.
- It can be the result of embedding new and existing knowledge, along with activating and challenging latent knowledge.
- **Open innovation**
  - Not all valuable resources are or should be employed within an organization, but external ideas, research results can and should be integrated
  - Focus of value for our customers and their needs, rather than on internal capabilities and ideas
  - The winning competitive advantage is hidden on the business model, not always on the offering itself

Forms of innovation

Innovation can be built up systematically. Here are different forms of innovation, for instance:

- **Radical vs. Incremental innovation**

Radical innovation refers to new offerings that are based on totally new ideas and provide a solution with new competencies and capabilities, whereas incremental innovation is based on enhancing and improving existing knowledge base and competencies

- **Architecture vs. Component innovation**

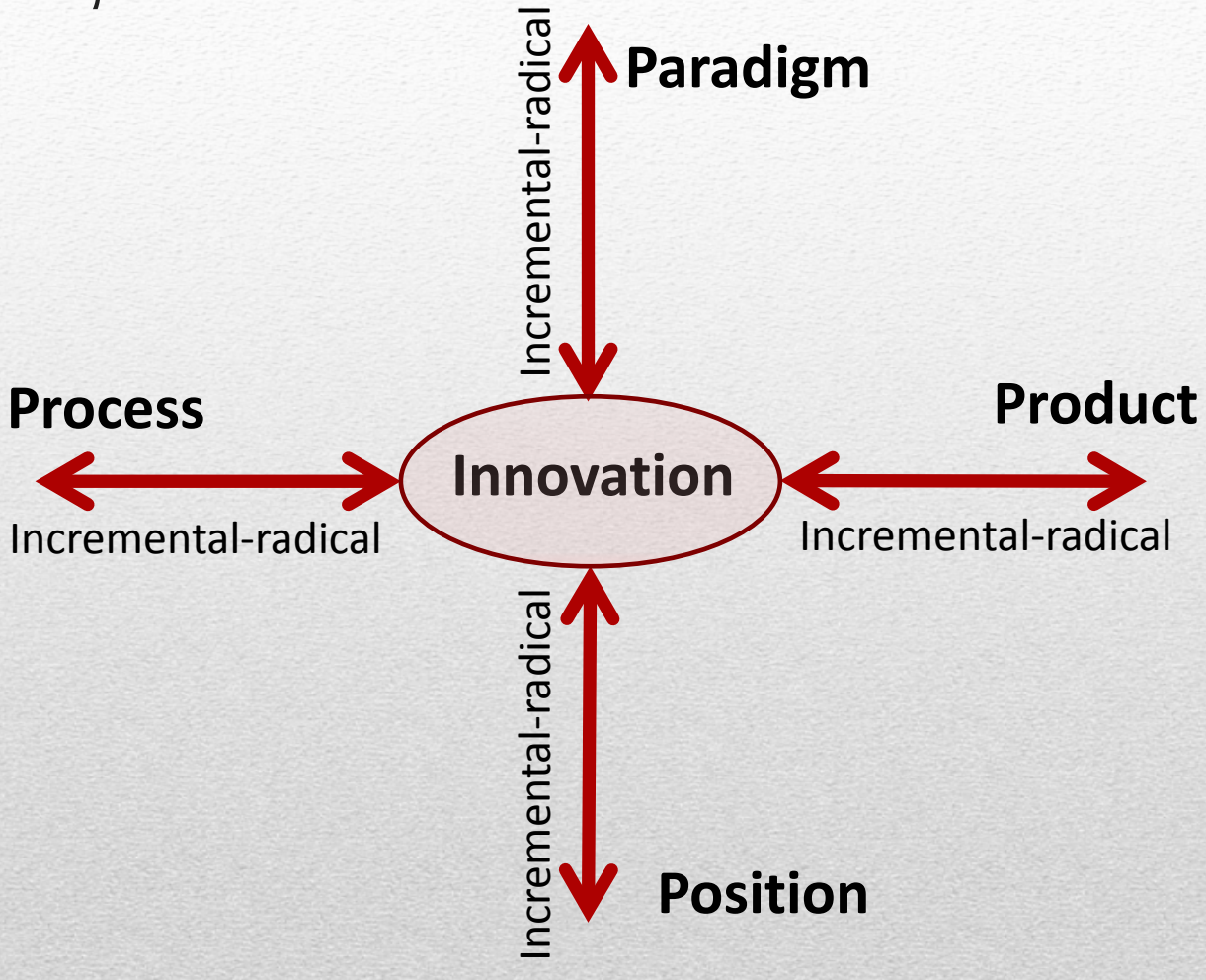
Changing the overall architecture and design of a system or the interaction of different parts within it is different from designing a new component or module of it , without completely altering the way it is originally *"built"*

Types of innovation, the "4Ps"

According to the *"4Ps"* framework, developed by Bessant and Tidd (2005), the four dimensions of innovation are described as follows:

Product innovation: Changes, updates and improvements to the products or services offered to the consumer; the most commonly perceived type of innovation

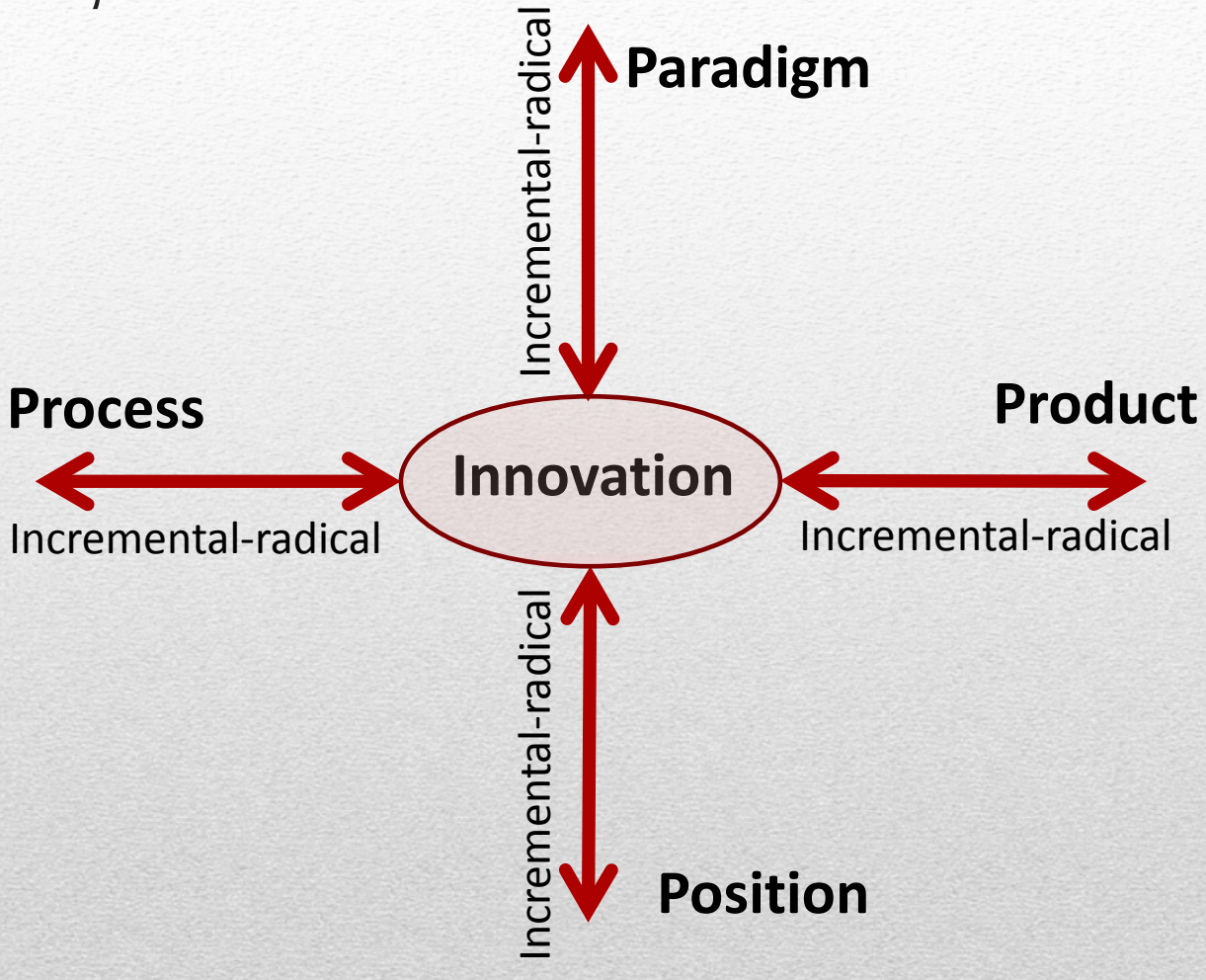
Process innovation: Changes in the way the products or services are built or delivered to the customer. Refers to new ways of accomplishing things



Types of innovation, the "4Ps"

Position innovation: When changes in the way and the environment in which products or services are offered or communicated. Refers to new markets, new opportunities

Paradigm innovation: Referring to the business model employed and/or competitive advantages and the values/needs on top of which they are based, the ones that differentiate a solution from the competition.



Types of innovation, the "4Ps" and DCs

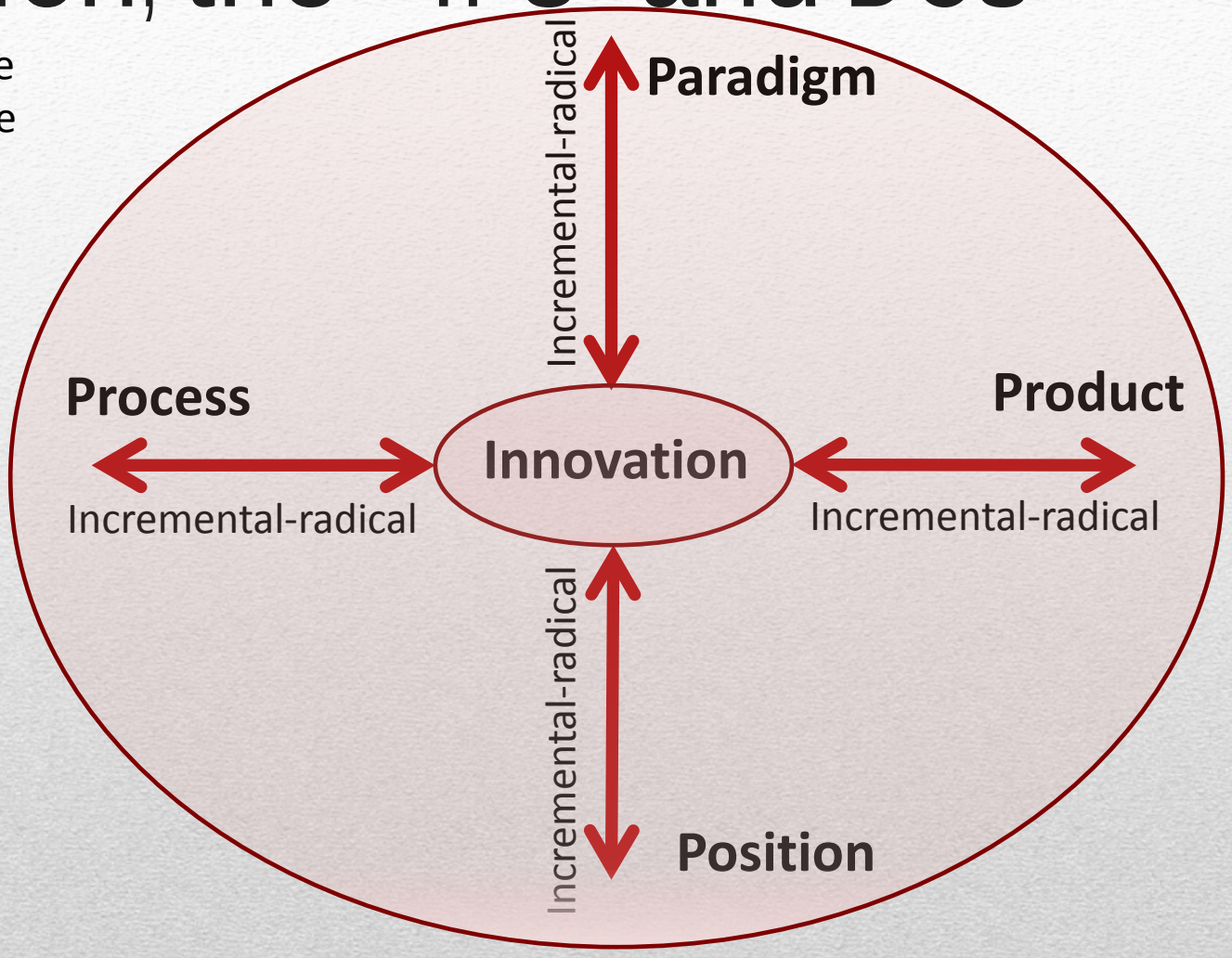
In relation to digital currencies, one can make the following comments for each pillar of the model:

New **paradigm**: Currency with no central Issuer, decentralized and transparent operation

New **process**: distributed consensus ledger updated globally, decentralized clearing

New **product**: Disintermediated transactions at a distance (service)

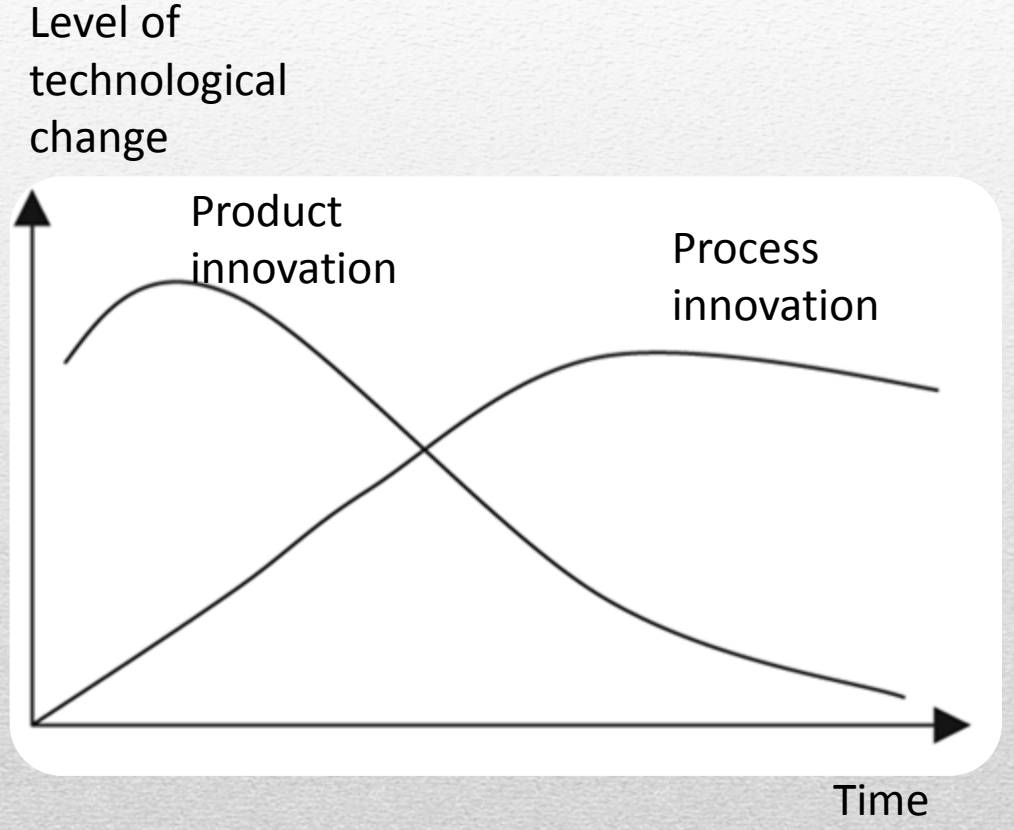
New **position**: The Internet as a means of disintermediated financial communication between parties



The innovation lifecycle

The innovation lifecycle illustrates the level of technological change over time for a new innovation. A new product often leads to new processes. This is the typical pattern, it is representative of most but not all innovations.

As Bitcoin for instance is beginning to solidify as an innovation, we are seeing complementary processes being built on top of it, to make it more diverse (Mastercoin, Ethereum, etc.), more secure (HD wallets, multi-signature transactions, BIP38, BIP70,etc.), and more easy to use (Coinbase, BitPay, Circle, etc.).



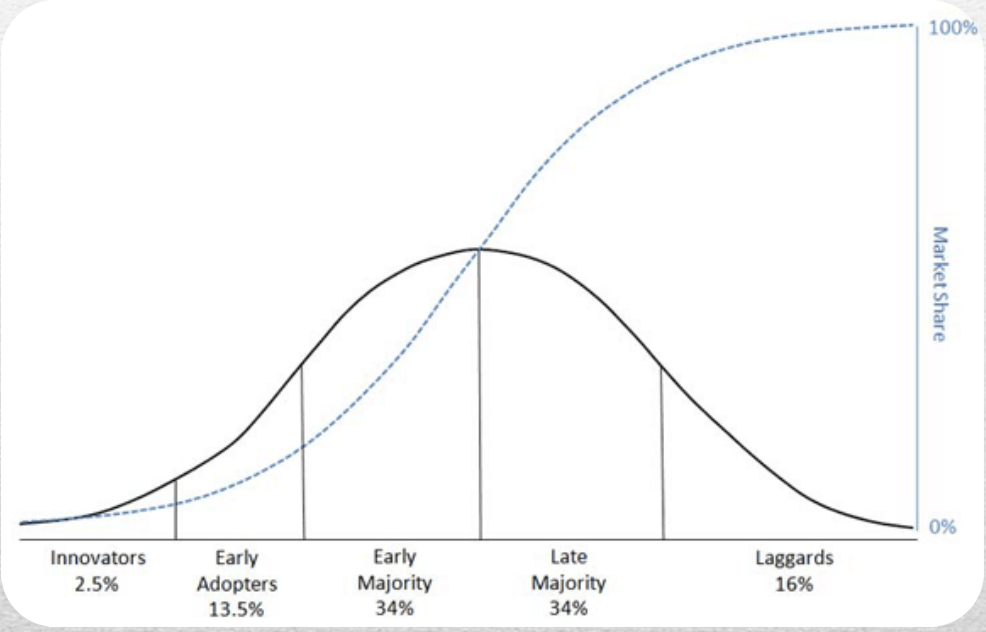
Everett Rogers Diffusion of Innovations, Model (1962)

Diffusion of Innovation

Diffusion of Innovation

The first graph captures two of the most central concepts in innovation. The first is the diffusion of innovation in terms of the people adopting it. There are five distinct groups and as you can see it generally follows a bell shaped curve, also known as a *"normal"* distribution.

Not all innovations have this exact trajectory but for most successful innovations there is a slow start then a high degree of interest and then at some point the interest decreases either because everyone now has one or because something new took its place.



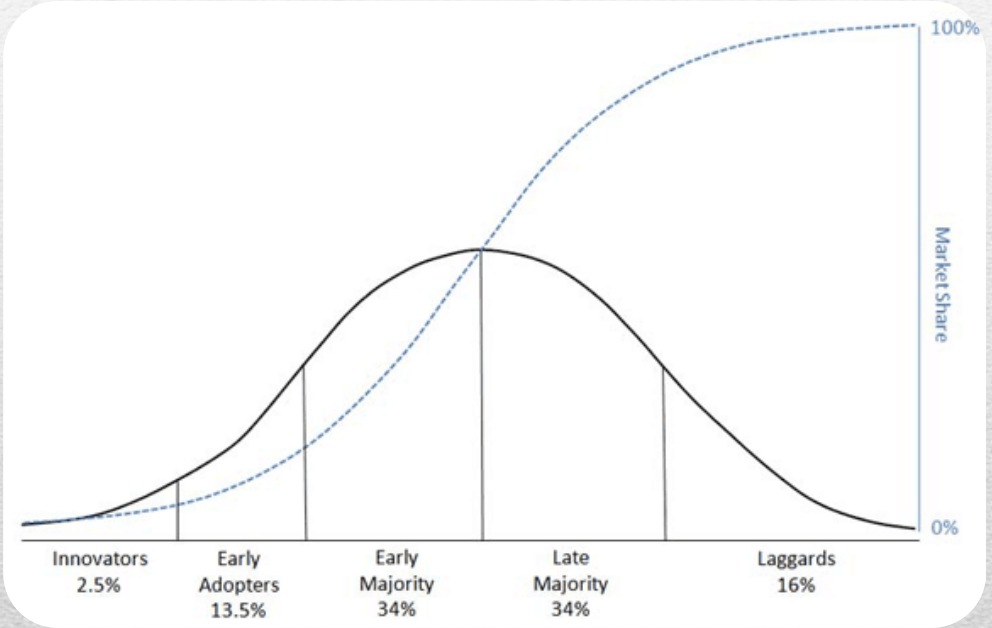
Everett Rogers Diffusion of Innovations, Model (1962)

Diffusion of Innovation

Each of these categories have distinctive characteristics:

Innovators: Seek new ideas, can cope with uncertainty and increased risk, broader perspectives.

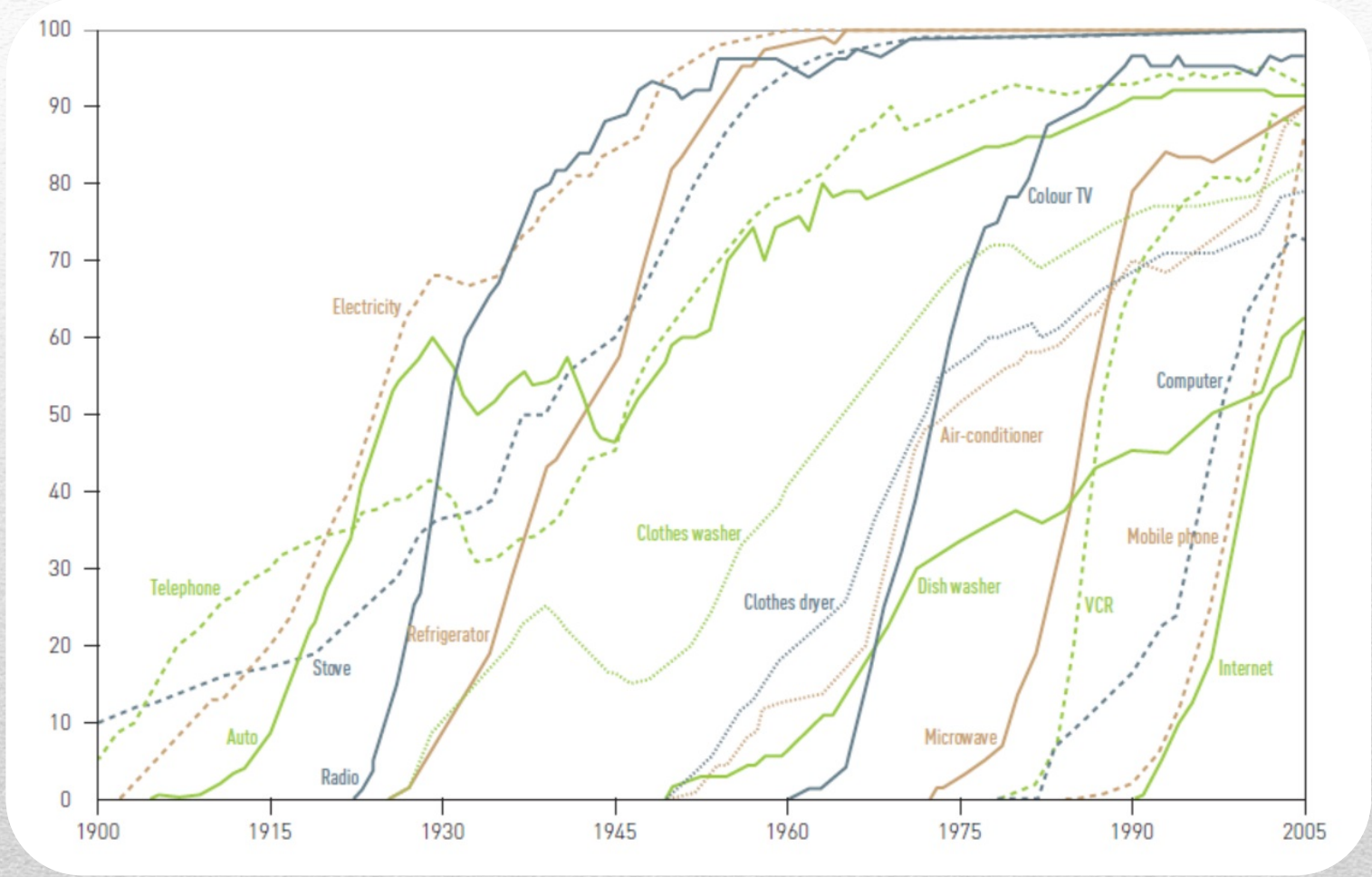
Early adopters: More localized and less global perspective, their opinion is more respected than innovators, often leaders, tend to back *"winners"*.
Early majority: More cautious, not usually leaders, prefer a strong preexisting backing before they adopt.
Late majority: May adopt only when they feel pressure to do so by peers. Will only join once uncertainty is reduced.
Laggards: Not opinion leaders, less sociable, focus on the past, innovators may have moved to a replacement by the time the laggards adopt.



Everett Rogers Diffusion of Innovations, Model (1962)

Diffusion of Innovation

The second graph on the previous diagram, superimposed on the first, is the “S-curve” of market share. This refers to the cumulative market share that a successful innovation would follow finally reaching 100% saturation. The graph on the right is depicting some examples of the adoption rate of everyday consumer products.



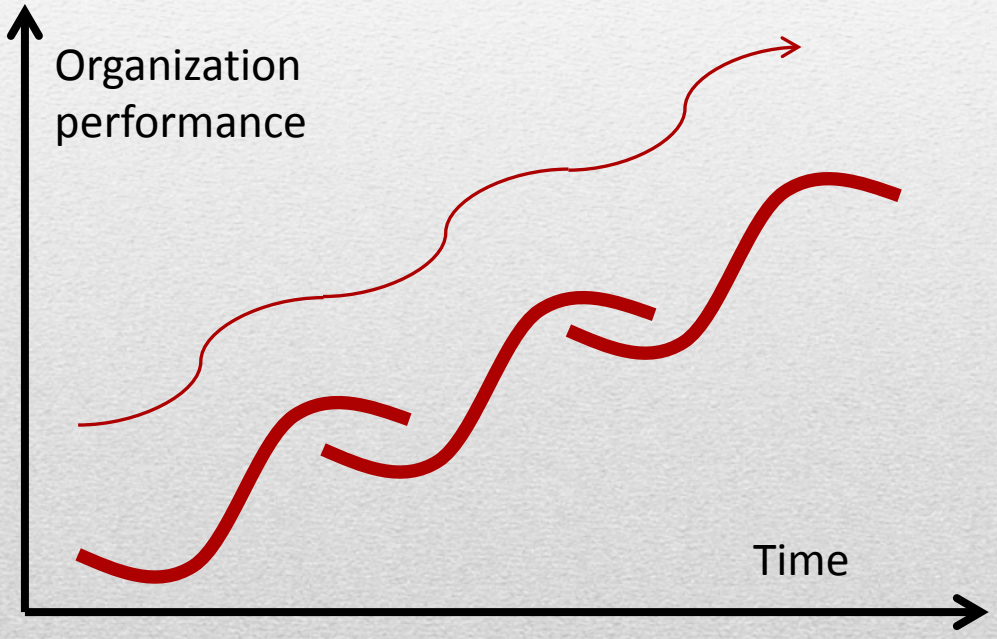
Source: http://slickercity.net/tag/information-communication-technology/

Diffusion of Innovation

As most successful innovations follow an S-curve of adoption, organizations try to promote the next successful innovation at the right time in order to maximize the overall performance. Too soon and they will *"cannibalize"* the previous innovations market share, too late and something else will *"steal"* the initiative.

If the new product or service needs to be ready at a specific period then the preparation needs to start earlier, possibly half way through the previous S-curve. This period is referred to as the innovation window. Using the word window further suggests it is an opportunity that can be missed if the timing is not right.

Climbing and jumping S-curves



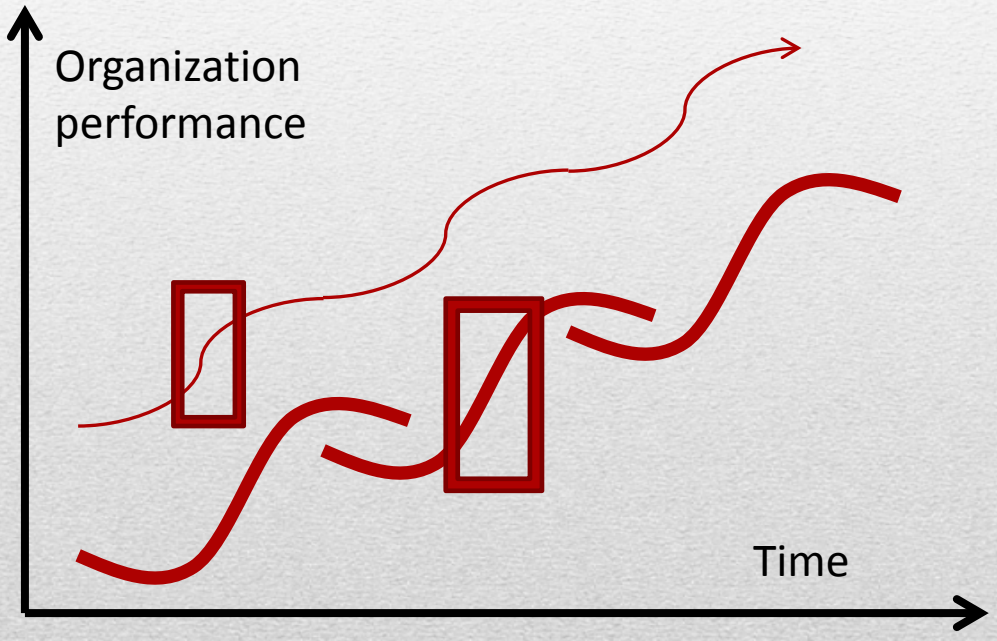
Everett Rogers Diffusion of Innovations, Model (1962)

Diffusion of Innovation

Usually, S-curves are not that smooth as the ones depicted in the diagram; the actual curves are full of ups and downs, highlighting major events that affect the adoption or negative view of a new product or service by the market.

There is this part of the S-curve, known as the *"vertical"* part, that is depicting the point in time that major adoption of a new idea or business venture takes place. At this point, increase of users / adoption is expected to be exponential.

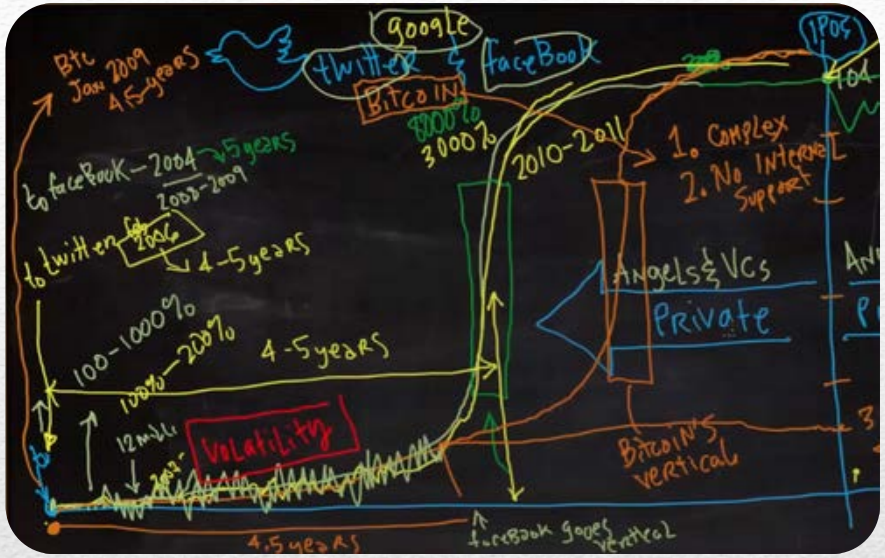
Climbing and jumping S-curves



Everett Rogers Diffusion of Innovations, Model (1962)

More on the S-curve

James DeAngelo, in this video explains why Bitcoin's growth is normal and how it is compared with Facebook and Twitter and their adoption.



Briefly, Bitcoin adoption is observed to be closely related to the adoption rate and pace of the aforementioned ideas, in their first 4 or 5 years of development. However there are some key differences:

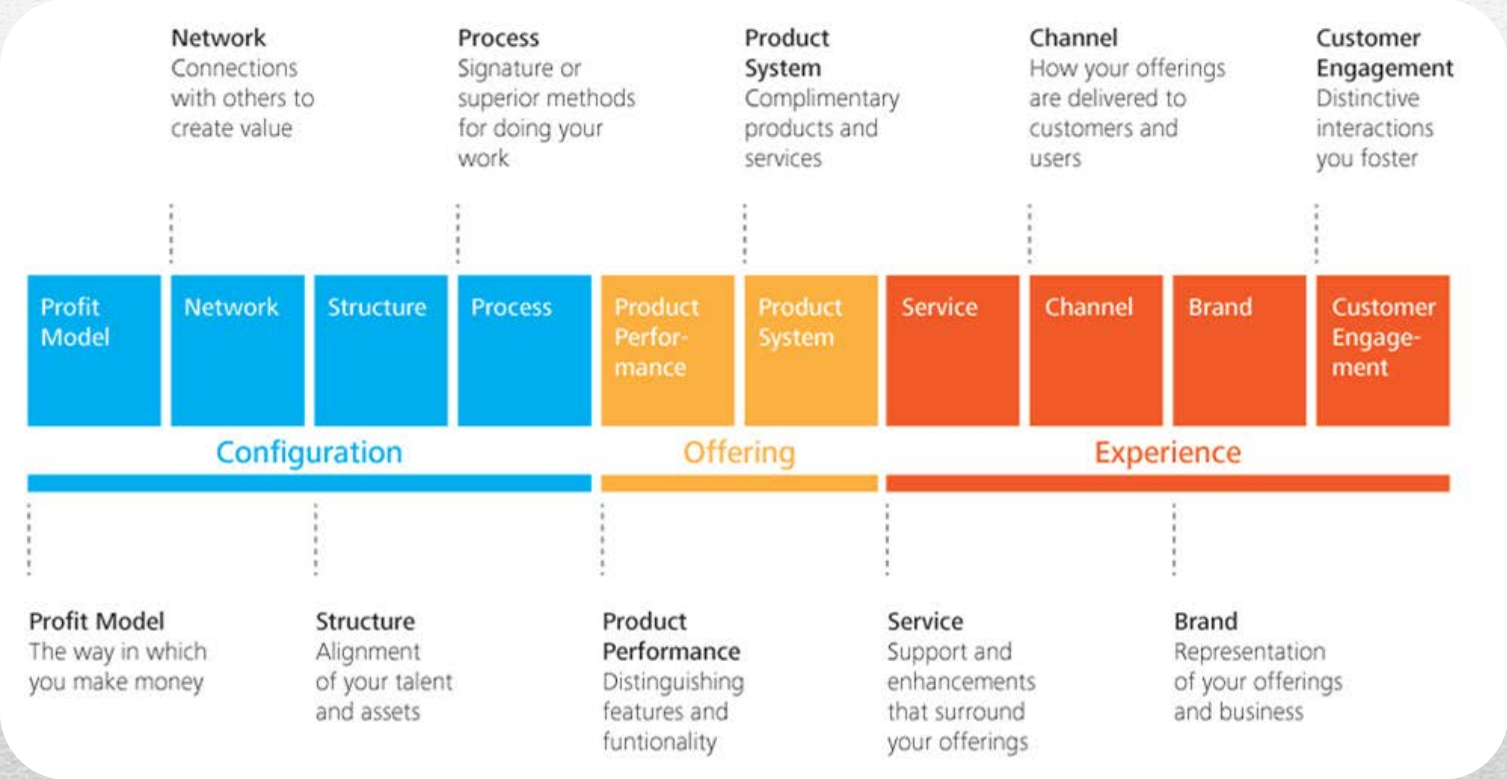
- Bitcoin is a much more complex idea and technology, disrupting more than one fields of operation whereas Facebook and Twitter are, at the end of the day means of communication.
- Secondly, there is no Bitcoin enterprise or business, so there are no marketing and promotion expenses and material to boost its awareness and promote its adoption.
- Thirdly, Bitcoin is yet accompanied with a high degree of volatility

The aforementioned factors are expected to *"delay"* the vertical part of the Bitcoin S-curve.

The ten types of innovation

Keely et al, 2013, proposed a new definition of innovation, looking at ten pillars – aspects around an offering that can bring and incorporate disruption and innovation.

According to Keely, successful innovators analyze the patterns and insights that can emerge from their industry, which can lead their choosing the right path to innovate, consciously , systematically and methodically.



Source: Ten Types of Innovation (Doblin, Chicago Institute of Design, Deloitte Development LLC, 2014)

The network effect

Innovation that connects users to each other to build a network have an additional element as the value of the network largely depends on how many people are using it.

As in the case of the telephone, where the more people using it, the more people could be connected by it , leading to a feedback loop where the innovation itself became more valuable thus bringing in more users, and so on, the network effect is very important for Bitcoin as well.

Metcalfe's law describes the value of such a network as being proportional to the square of the number of the participants of the network. This is especially valid as the number of connections possible to the network increase exponentially with the number of participants.

- What other innovations beyond the telephone and Bitcoin can you think that take advantage of the network effect?
- Does Bitcoin perhaps take advantage of the existing network effect provided by the Internet to achieve a meta-network effect?

Disruptive innovation

The term coined by Clayton Christensen. Certain characteristics are usually present regardless of the period or nature of the technology.

- Eventually 'destroys' the previous technology through a process that may take years.
- May focus on unstated or future needs as opposed to current needs.
- Best firms focus on customers' current or near future needs and may miss needs further in the future.
- Takes the market and value network of the previous technology.
- May start as a simple application at the bottom of the market (Christensen 1997).
- May start as a less sophisticated cheaper alternative.
- The innovators dilemma: Focus on customers or the future?

Even though Christensen has attempted to generalize the coined term, we should keep in mind that not all these elements need to be present at the same time for an innovation to be classified as *"disruptive"*.

Why Bitcoin is an Innovation

Why Bitcoin is an Innovation

- Bitcoin as a digital currency, is gaining momentum in multiple marketplaces, bringing in **benefits** for both **companies** (lower transaction fees, instant transactions, no chargebacks, simplified payment processes) and **consumers** (lower or no fees to transfer value / send bitcoins globally, pseudonymous transactions, no intermediary i.e. financial institution, controlling currency).
- It is an **open source monetary system**, based on open standard security protocols. It is backed by a transparent core infrastructure (protocol and mining power), using incentivized participants (miners) to provide transaction consensus between all users of the peer to peer network, so they can objectively transact without intermediaries, with the currency of the network (bitcoins).
- According to the PwC report, *"Bitcoin enables companies to skip the "middle man" of central financial institutions and their fees"*. Thus, Bitcoin's value proposition brings banks, governments, payment processors and payment gateways in front of interesting challenges.
- However, we should not forget that the most prevailing innovation lays at the foundation of the Bitcoin currency application, the Bitcoin protocol and the blockchain technology.

Why Bitcoin is an Innovation

- The Bitcoin protocol, addresses and provides a probabilistic solution to the Byzantine General's Problem, a problem of how to achieve consensus among peers in the same network that has not been successfully addressed in the last decades of research.
- It enables disintermediated financial communication with lower fees than other, more conventional means.
- It provides the opportunity for increased privacy.
- The blockchain is a public transaction ledger, maintained at every full node of the network; meaning that it can act as redundant backup of transactions, in many distributed copies, making it significantly more resilient than centrally stored ledgers.
- It is highly portable, with the use of brain, paper and hardware wallets and it is accessible wherever there is internet connection.
- Bitcoin as a currency is the first application of this innovation, with ramifications that can be applied to nearly any ledger system (asset, ownership, activity) to make them more transparent and increasingly robust/fault tolerant.

Stepping on the Shoulders of Giants

Bitcoin as an innovation is based on a number of technological achievements of the last decades, successfully combining and taking them a step forward:

- The open network of the Internet
- Open source development, enabling transparency and open innovation; in the same framework as the Linux operating system
- Asymmetric Cryptography, used to generate private/public keypairs
- The Hash Function, as a process to *"translate"* inputs, independently of their size, to outputs of specific size, named *"hashes"*
- The Proof of Work concept, i.e the provable expenditure of computational resources towards a commonly agreed-upon goal.
- The use of Peer to Peer networks, on which innovations like Bit Torrent are based, especially combined with the requirement of consensus of the majority of the network for a transaction to be verified or a change or improvement to be implemented

Elements working synergistically

Beyond the innovations that already made Bitcoin and the blockchain technology possible, a large set of added elements and factors could be considered to be helpful for the easier and more widespread adoption of these and affiliated technologies.

- Increasing Internet adoption
  By 2020, 66% of the (then) global population of 7.6 billion is expected to be online
- Moore's *"law"* for scaling
  Moore's law is more of an observation than a law; processing power and with it implicitly, storage capacity and bandwidth develop at an ever increasing pace, following the rough outlines of an exponential function.
- Increasing Mobile adoption
  More people progressively have access to mobile phones and the internet than to conventional banking services.
- Increasing centralization/systemization of conventional financial services
  Satoshi famously quoted a newspaper headline in the Genesis Block : *"The Times 03/Jan/2009 Chancellor on brink of second bailout for banks"*

Socio/political leverages

Notwithstanding the technological elements of innovation, a few other elements aid towards adoption by giving incentives to users. While a technology or innovation may have enough merits to stand on its own in the market, these incentives are an added push that aims towards a more viral adoption of an innovation that is not always possible with conventional innovations. In this case monetary, speculative and political underpinnings come into play to augment the nurturing and spreading of an already innovative technology.

- Increased appreciation by groups sensitive to privacy (Cypherpunks)
- Increased appreciation by Libertarian, Agorist and Anarcho-capitalist movements (separation of State and economic Activity)
- Transparency of monetary basis, issuance rules, provable compliance to the rules (PoW)
- Voluntary Participation
- Early adopters that initially assume more risk have higher incentives to work towards wider adoption. Latecomers enjoy less risk and less rewards as reward rates/issuance decreases
- Network protection and transaction processing directly linked to monetary rewards (mining)

Democratized and Permission-less Innovation

Innovative technologies many times emerge as a solution to a known market or unsolved research problem, or as a means to perform something in an incrementally better, more time and/or cost effective manner. Innovation can therefore be reactive to existing technologies. When these innovations are *"open-sourced"* (not patented or under conventional IP protection schemes), anyone is mostly free to work on them, and consequently improve them. This allows their faster dissemination and propagation as well as the decentralization of the innovative process which occurs directly from the users. Notable examples are:

- **3D printing**

response to conventional manufacturing processes and supply chains

- **Bit Torrent**

response to aggressive control of digital content distribution rights

- **Bitcoin**

response to centralization and inefficiencies of financial services

- **Open genetic engineering**

response to aggressive IP protectionism of major GMO companies (Monsanto, etc.)

Bitcoin and Anti Fragility

- Anti-Fragile systems are not only resilient to external attacks, but adapt beyond them to prepare for the next interventions
- Bitcoin has displayed Anti-Fragility through software bugs (8/2010), a hard fork (3/2013), regulatory pressure (12/2013,China), and support for other applications (e.g. voting / 2015). It is not unlikely that it will remain flexible
- Consensually driven by those that have interest in its survival, minimizes the risk of hostile take-overs
- Actors in the system that could act against it are incentivized to work in its favor

As we saw in the last (near) 51% control of the hashing power by Ghash.io, miners or pools did not perform attempts to double spend or fork the network. Such an act would seriously undermine the network's value, the exchange rate of bitcoins mined, and therefore their investment in mining equipment.

Bit Torrent as a comparison

- Bit Torrent is defying conventional digital content distribution and copyrights and is unlikely to disappear.

- Large scale file sharing started from Napster. Napster was shut down as it was a centralized effort with semi-centralized infrastructure. The same largely happened with KaZaa(FastTrack) and eDonkey. Gnutella survived due to being largely decentralized despite the initial protocol (Limewire) being eventually shutdown. Bit Torrent is widely used by companies as Facebook and Twitter, and has thrived despite the controversy surrounding illegal file sharing. This is largely attributed to being a very useful method of sharing large files between peers, and also being very distributed in nature.

- E-gold and Liberty reserve were early attempts towards the privatization of money but they were centralized like Napster

- Is Bitcoin the Bit Torrent to the *"Napster"* of E-gold and Liberty Reserve?

Creating space for more Innovation

Future Giants on Top of Bitcoin

Beyond the blueprint and the first applications of an innovation, almost always, new innovations strive to improve, replace and complement it. Especially when the source code of such an innovation is freely available to all, this is an invitation for further development and experimentation. The concept has already been used in efforts to decentralize the internet, smart contracts, distributed ownership and much more is sure to come.

- The concept of the blockchain for distributed consensus aiming towards decentralizing the internet (Maidsafe, Storjcoin, Proof of Resources, etc.)
- A large number of alternative approaches that can exist in parallel without being directly competitive in the short term (Ethereum, NXT, etc.)
- An unlimited amount of sandbox/testbed currencies that can be issued by anyone, without permission, to test other approaches (altcoins like Primecoin, Freicoin, Peercoin, etc.)
- Sidechains will allow for highly varied alternative blockchains that are intrinsically connected with Bitcoin as a funding mechanism and provide an avenue of ingress/egress of value in them
- The power of the Bitcoin network against tampering, used for smart contracts and any other digital ownership ledgers, and decentralized trading thereof (Colored Coins, Omni, Counterparty)

Outlier innovation and Black Swans

In the words of Nicolas Nassim Taleb, who developed Black Swan Theory:

- **The event is a surprise (to the observer)**: Bitcoin appeared as a completely unexpected solution to a problem not apparent to everyone
- **The event has a major effect**: More than 70,000 businesses accepting and several million wallets/client downloads in 5 years of operations, roughly 4 billion dollars market capitalization
- After the first recorded instance of the event, **it is rationalized in hindsight**, as if it ***could*** have been expected; that is, the relevant data were available but **unaccounted for** in risk mitigation programs. The same is true for the personal perception by individuals.
- Distributed consensus applied to financial systems studied since early 80s (David Chaum, Wei Dai, Nick Szabo, Adam Back et al)
- The financial industry did not innovate as fast as the tech industry (internet payments inefficient after 30 years of the internet, SWIFT and ACH systems develop very slowly)
- Failure of systemic financial institutions would pronounce the need for less centralization, more transparency

Black Swans are countered by Anti-Fragility: Since they cannot be anticipated, systems should be built in manners that would exploit positive Black Swans and protect against Negative Black Swans

Digital Currency and Innovation – A preview of MGT-523 (MSc)

A preview of MGT-523 (MSc)

There's much more to cover with regards to digital currency and innovation – like how innovation is related to management and how it has historically affected it, and much more:

- **Theory & Diffusion of Innovation –** Theory, characteristics and case studies in technological and disruptive innovation, the nature of innovation, sources of innovation, and digital currencies as products of innovation
- **Management of Innovation –** Strategy and business models for innovation, avoiding obsolescence, sources and networks of innovation, introduction to new technologies that are transforming business, and how to finance innovation
- **Implementation of Innovation –** Creating new products/services/processes, open innovation and collaborations
- **Application of Innovation –** Incorporating innovation into the organization and reaping the benefits/learning outcomes, application of innovation to digital currencies and study of risks and challenges

All of the above are covered by MGT-523 Principles of Disruptive Innovation from the MSc.

MGT-523 (MSc) – Theory & Diffusion of Innovation

Key topics explored are:

- What is innovation and why it matters to any modern organization
- In detail view of the Dimensions for innovation, such as:
  - Product
  - Service
  - Position
  - Paradigm
- Creating and capturing value: mature vs. dynamic approach
- The process of how innovation happens – searching & scanning the environment, filtering & selecting opportunities, implementation & development, post-review and learning
- Building innovation into the organization, and the three capabilities – creative climate, deliberate process, inclusive leadership
- Styles of leadership and effects – e.g. visionary, transactional, or participative
- Organizational climate vs. culture characteristics and limitations
- Innovation assessment and opportunity gaps

MGT-523 (MSc) – Management of Innovation

Key topics explored are:

- Innovation strategy development and factors influencing value delivery – e.g.:
  - current systems of innovation,
  - power and market position,
  - capabilities and processes of the firm, and
  - the exploitation of external sources
- Strategic management:
  - Rational/planning and its limitations, or
  - Resource-/Capabilities- based and its limitations
- Strategy concepts, such as Red vs. Blue Ocean strategy
- Geographic factors influencing innovation, such as: input prices, natural resources, tastes, etc.
- Strategies for idea/concept generation, such as: research, imitation, aspiration, etc.
- Characteristics and attributes of creativity and creative problem solving
- Innovation networks and their types, such as: entrepreneur-based, internal team, communities of practice, open innovation, lead user innovation, etc.

MGT-523 (MSc) – Implementation of Innovation

Key topics explored are:

- Identifying opportunities for innovation, patents as indicators of innovation, forecasting and its disadvantages, the contrast with open source innovation
- Anticipation of trends – quantitive/normative forecasting, scenario development, the Delphi method, etc.
- Characteristics of disruptive innovations, and looking deeper on why Digital Currencies are a disruptive innovation
- New product/service development, and factors affecting their success, dimensions of product advantage (e.g. unique benefits for customers)

Conclusions

- Innovation may be an industry push or a market pull activity.
- Innovation is generally distributed in the model of an S-curve.
- Bitcoin is an innovation that leverages, and is based on, many innovations before it.
- Bitcoin will itself be the fulcrum and crucible for a large number of innovations to be built upon it.
- Bitcoin takes advantages of several other elements beyond technological innovation.
- Bitcoin could be considered to be a Black Swan and has some properties of being Anti-Fragile.

Self-Assessment Exercises and Further Reading

Self-Assessment Exercises

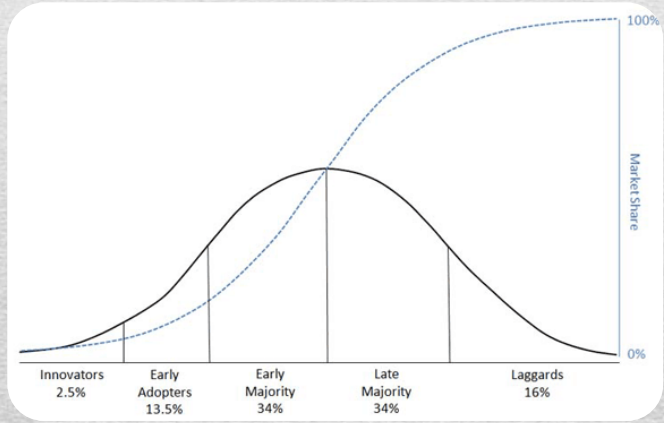
Discuss, in the appropriate threads in the forum, the following issues:

1. In reference to the graph in page 12, do you notice a pattern as we are moving from left to right (closer to today)? Why do you think that is?
   [Tip: Research online to describe how you think that relates to the term *"Technological Singularity"*]

2. What other elements/graphs beyond the exchange rate of Bitcoin to the USD are you able to find that could substantiate that Bitcoin as an innovation is following an S curve for adoption ?

3. Using relevant sources and what you have learned today assess where on the diffusion of innovation bell curve, digital currencies lay. Furthermore, consider whether they need to reach 100% market share to be successful.

4. What would you consider to be the elements that govern the network effect of Bitcoin and make it superior to other similar networks?



Further Reading

Disruptive innovation: http://www.claytonchristensen.com/key-concepts/

Hippel, E.V. (2005) Democratizing Innovation, Cambridge: MIT Press.
http://web.mit.edu/evhippel/www/democ1.htm

Chris Dixon: The Next Big Thing Will Start Out Looking Like A Toy
http://cdixon.org/2010/01/03/the-next-big-thing-will-start-out-looking-like-a-toy/

Fred Wilson: Return and Ridicule
http://avc.com/2013/04/return-and-ridicule/

Duivestein Sander, Savalle Patrick, BITCOIN 2.0, It's the platform, not the currency, stupid! A bitcoin vision by @duivestein and @patricksavalle. Available at http://www.slideshare.net/patricksavalle/bitcoin-20

Further Reading

PwC Consumer intelligence series : *"Digital Disruptor: How Bitcoin is Driving Digital Innovation in Entertainment, Media and Communications"*
http://www.pwc.com/us/en/industry/entertainment-media/publications/consumer-intelligence-series/assets/pwc-consumer-intelligence-series-bitcoins-entertainment-media-communications.pdf

An Investigation of the Theory of Disruptive Innovation: Does the Cryptocurrency Bitcoin Have the Potential to be a Disruptive Innovation Relative to an Existing Market?
http://www.soc.napier.ac.uk/~cs104/mscdiss/moodlemirror/student/d3.pdf

Questions?

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