

Emerging Technologies and Issues: ISYS90032

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Week 1: Introduction to Emerging Technologies

ISYS90032: Provide powerful and long-lasting frameworks/theories that help you understand **how** technologies emerge and **why** some succeed and some don't

Towards the second machine age

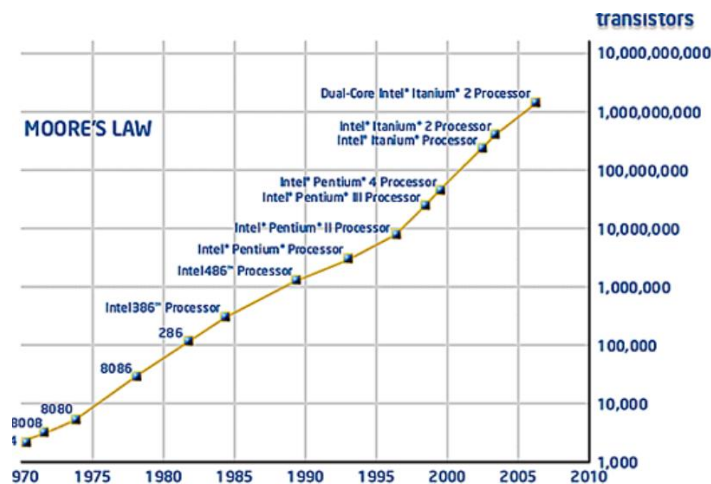
General Purpose Technologies (GPTs) lead to revolutions

- Steam: Industry revolution (late 1700s) -> Shift agriculture to manufacturing
- Electricity: First Machine Age (20th Century) -> Increase automation of manufacturing, service
- Computers: Second Machine Age (NOW) -> Ubiquitous computing, physical and virtual intertwine

How did we get there? **Moore's Law**: # of transistors doubles every 18 months

- > Computational power doubles
- > Future developments

Can expect exponential growth (as it doubles every time)



Impact of tech?

Every way of automation in the 19th and 20th Century **eliminated jobs and occupations** BUT:

- Organisational Innovation
 - o New organisational structures, business models
 - o Entrepreneurships (taxi driver vs fleet of self-driving cars)
 - o Innovation through technology
- Investing in HUMAN CAPITAL
 - o Education and up-skilling
 - o Understanding innovation, technology, adoption, and use

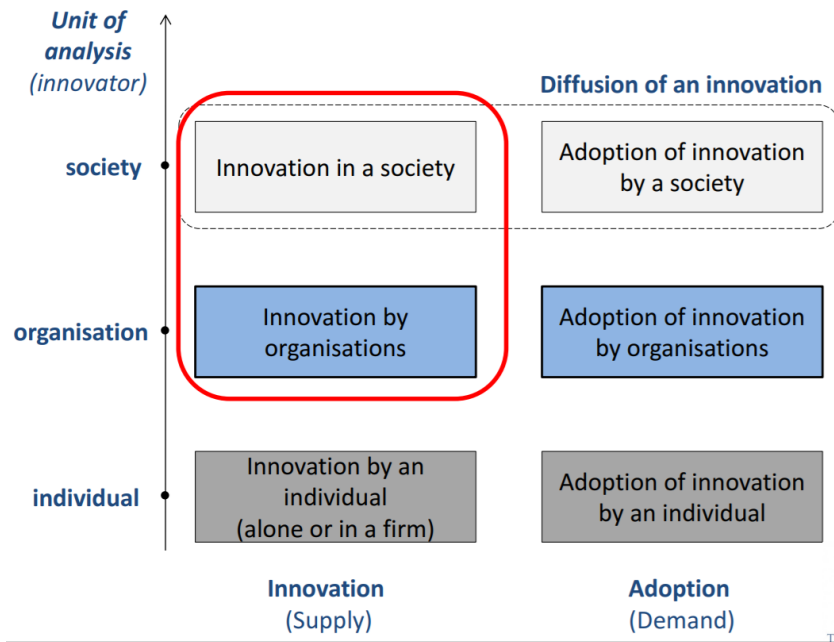
NOT 'man VS machine' but '**man WITH machine**'

Week 2: Theories of Innovation Part 1

What is Innovation?

- Progress in society – doing the same thing with new ideas
- Setting up a new production function
- A process that occurs only when something is entirely new
- The adoption of a change which is new to an organisation

Perspective on technology innovation:



Perspective on innovators (Supply)

Individual Level

- Creativity and prior knowledge enable innovative thinking -> Allows individuals to transform concepts from one field to another
- But, prior knowledge can also inhibit creativity as people become trapped in the existing logic
- Unless, innovators who are **members of two distinct knowledge domains are more likely to combining previously disconnected domains** (e.g. ICT and art)

Organisational/Group level

- Heterogenous teams (members with diverse background) -> MORE SUCCESSFUL
- Homogenous teams (members with similar background) -> Less successful

Teams using more sources of knowledge are more likely to generate innovations (different view point)

How do we define technology?

- Application of scientific knowledge for practical purposes, especially in industry
- Machinery and devices developed from scientific knowledge.

BUT: What IS technology?

1. Means to fulfil human purpose
 - Explicit purpose (oil refinery) vs implicit (computer)
 - Method (speech recognition) vs process (chemical engineering) vs device (diesel engine)
 - Simple (axe) vs complicated (MRI machine)
 - Material/tangible (electric generator) vs non-material/intangible (algorithm)
2. Assemblage of practices and components
 - Complex technologies (biotechnology) representing groups of many individual technologies and tools
 - Plural

3. Collection of devices and engineering practices available to a culture
 - Commonly used cultural entity
 - Singular

Now: What is the *NATURE* of technological innovation?

- Most innovations are not new -> Combination of elements that already exist
- RECOMBINATION of conceptual and physical materials

Therefore: Challenge for innovator:

- Not to think of something new, but to find combinations of existing things

COMBINATORIAL EVOLUTION: Nature of technological innovation

Simple types of technology form more complex clusters that become building blocks of more 'complex' technologies

- Silicone and metal -> chips -> smartphones

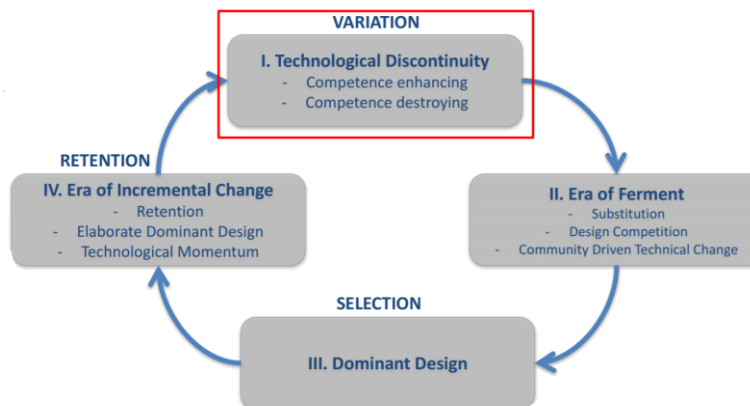
But, modern ICTs did not emerge from flint-tools. Humans constantly capture and understand natural phenomena

- Science (understanding of natural phenomena) + Recombination of resources = emergence of new technologies

Technologies creates itself out of itself. This mechanism is called 'combinatorial evolution'

Frameworks: Understand the processes that **LEAD** to the **emergence** of new technologies

1. Tushman and Rosenkopf's TECHNOLOGY LIFECYCLE



I. Technological Discontinuity

Technological discontinuities are rare, unpredictable innovations, which advance a technological frontier by an order of magnitude and which involve a fundamentally different product or process design (General Purpose Technologies typically represent technological discontinuities)

Types of technological discontinuity:

- Product discontinuity
 - Fundamentally different products
 - Command a decisive cost, performance or quality advantage over other products
- Process discontinuity
 - Fundamentally different ways of making a product
 - Improvement in the cost of quality of the product