ICT and science 2.0: technology-mediated trends and characteristics of new scientific practices

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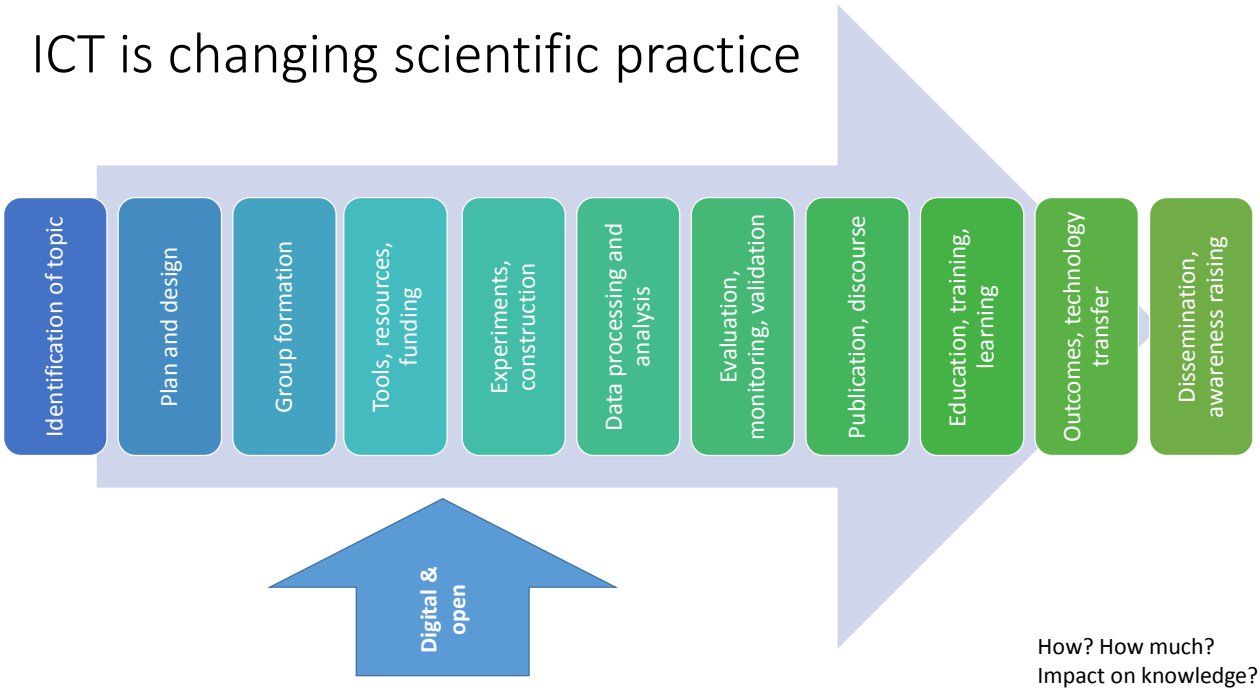
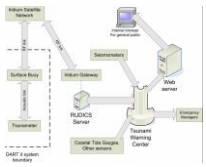
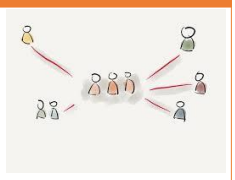
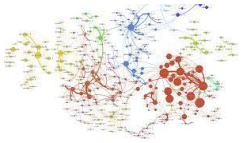
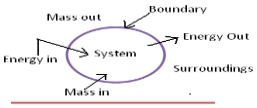
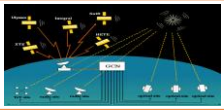
ICT is changing scientific practice



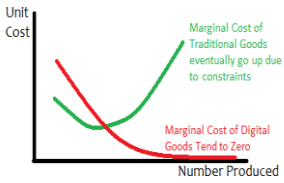
How? How much?
Impact on knowledge?

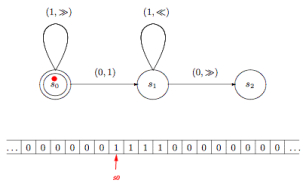
Process step	ICT usage
Topic selection, funding	Open peer review, crowd funding of research, online problem data bases and open innovation systems
Data collection	Big data, new sensor systems, automated data collection from 'internet-of-things', laboratory robots, interaction with citizens
Data analysis, generation of hypotheses and theories	Artificial Intelligence-based and statistical methods of knowledge discovery, data mining, interactive and visual data analysis; new computing infrastructure (including shared, distributed computing), interaction with citizens
Cooperation, discussion, valuation and critical reflection	New electronic forms of discussions, collection of micro-knowledge, interaction with citizens and artists, new metrics, reputation and recommender systems
Publication	Open access publication, open data (data re-use), open source software (software re-use), open methodology, collaborative writing, new media
Other aspects	Open methodology, open educational resources

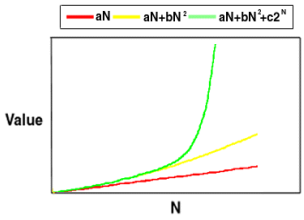
Similarities of ICT and Science 2.0 (ODS)

	ICT	Science 2.0
distributed		 
networked		
open		Google! OPEN ACCESS
global		

ICT characteristics







The download of a software copy does not generate additional costs (zero marginal cost). Today's **availability of free high-quality software** for large-scale interactive research supports free **access to scientific knowledge** (non-subtractible goods). Since there are also teaching materials, tutorials, etc. provided, **„club goods" can often be effectively turned into public goods today.**

The broad use of simulation in Science 2.0 is not just due to recent increases in computing powers, software and computing resources. **Visualizations of data** play an important role as well. They have become **interactive for human users** and relatively **easy to produce**. This may touch the very essence of what it means to understand.

Group networks facilitate the **exchange between arbitrary subsets of users** that have expressed interest in the same subject. Electronically mediated group discussions can **facilitate harvesting of knowledge** in a way that results in unexpected excellence. Drivers of this phenomenon are a large number of contributions and the **selection and composition of results.** (Metcalfe vs Reed)

Digital trends relevant for ODS


More with less: density, energy, cost


Software-driven world, data-driven approaches


Cloud and hybrid, computing infrastructure

Open data repositories


Mobile computing, internet of things, BYOD, intelligent interfaces


Open and build-your-own approaches, crowd sourcing, collaborative tools


Open and integrated systems, virtual experiments

- Tech trends suggest we have barely scratched the surface of using new ICT in RTDI.
- Societal developments propose a new generation of scientists is emerging that may have completely different attitudes and perhaps values.
- Some megatrends may significantly change the economic foundations of the current academic system.

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The future?

- Scientists will work in a massively **connected, electronic world**
- **Computing time is abundant**, energy is free, intelligent software dynamically exploits all computing devices world-wide
- Research funding agencies are replaced by **crowdfunding**
- **Death of privacy**: all data, programmes and results go online immediately
- Peer review is replaced by **recommender and reputation systems**
- construction of observables and asking the right questions will remain a human creative endeavour.
- The future scientists will be used to **results being available immediately** and free computing resources provided on the internet. They will not be shy to use "quick and dirty" computing resources including software and data provided by large companies.
- re-valuation of the impact of research and science, larger degree of **flexibility** in methodology
- Some of the strict rules will be replaced with speed, convenience and **immediate usefulness**.
- Innovation will become a much bigger immediate driver for science and research.
- While useless information may create a lot of noise, useful information is likely to be quickly selected by **the crowd and its wisdom**.