

Monika Gisler, Didier Sornette, Gudela Grote

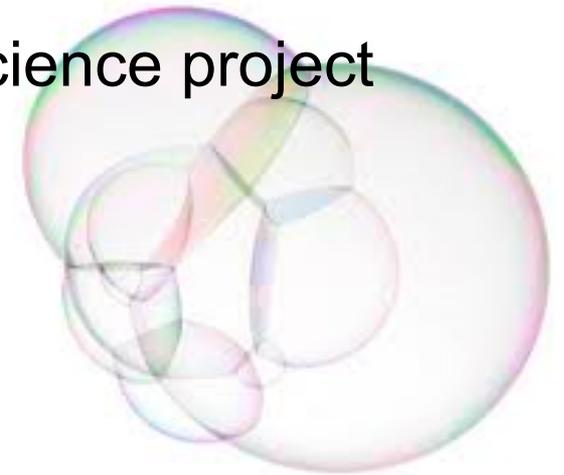
Exuberant Innovation: The Human Genome Project

Genomics in Society: Facts, Fictions and Cultures 23/24 April 2012



Context

- Innovation Studies / STS
- Social Bubbles Concept
- Case study: The Human Genome Project
- => example of a scientific project/big science project

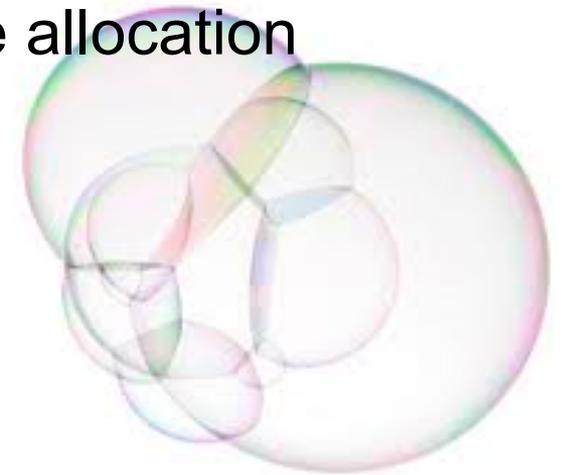


Innovation Studies / STS

- Innovation generally is seen as basic for economic, social and cultural development
- Premise: Private sector is focused on product innovation, interested in short term risk-taking and gain/return
- In big science other financing models are needed; yet government/ tax payers/ science foundations, are not necessarily in the position to invest into large scale projects – or objected for investing in one major project instead of several smaller projects

Social Bubbles: Research Questions

- → What necessary ingredients, what basic conditions have to be fulfilled to interest individuals or groups to invest into a scientific a/o technological project?
- → Interested in new models of resource allocation



Social Bubbles

- Dynamical environment is needed to foster investment mechanisms – like in a bubble
- → Creation of the **concept of social bubbles ...**



Financial Bubbles: Definition

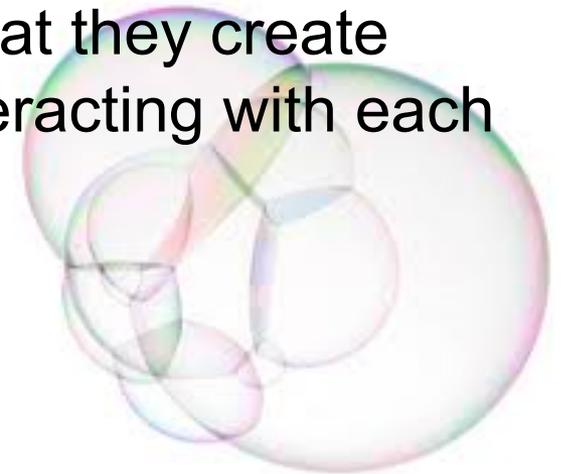
- Bubbles occurring in an economic context are seen as 'optimistic predictions about the future that prove wrong'
- .. a momentary appreciation of prices above fundamental value, resulting from excessive expectations of future capital gain ...
- Five steps distinguished (Kindleberger 1978; Shiller 2000; and others):
- (i) Displacement: Changes in economic circumstances create new and profitable opportunities for certain companies
- (ii) Euphoria or overtrading: A feedback process sets in whereby rising expected profits lead to rapid growth in share prices
- (iii) Mania or bubble: The prospect of easy capital gains attracts first time investors and swindlers, eager to profit
- (iv) Distress: Insiders discern that expected profits cannot possibly justify the now exorbitant price of the shares and start to sell (with profit)
- (v) Revulsion: As share prices fall, outsiders run for the exit, causing a bubble to burst

Social Bubble: Definition

- Enthusiastic supporters of an idea/an opportunity weave a network of reinforcing feedbacks based on exuberant anticipation that lead to widespread endorsement and extraordinary commitment
- i.e.:
- Evolvement of new opportunity/idea/concept that attracts supporters
- Large expectations toward the outcomes
- Feedback process: Different actors, including the public, come into play; ready to take large risks / to invest (time, money, reputation)
- Credit creation via private and public investments; proliferation of ventures of all kinds
- Saturation of the idea; project termination

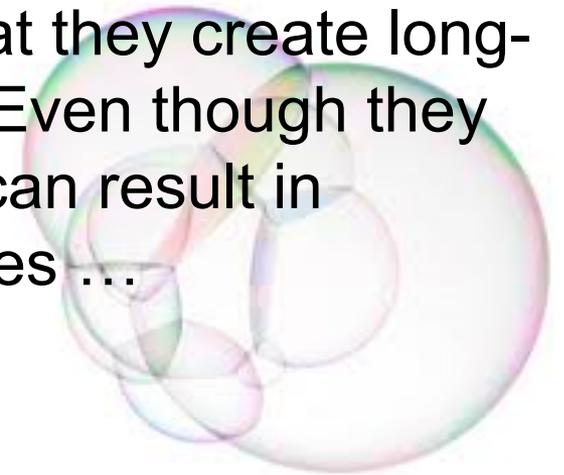
Social Bubbles

- The social in social bubbles is about the interaction of scientists, engineers, technicians, politicians, entrepreneurs, society, the media
- The bubble in social bubble is about what they create (under certain circumstances) when interacting with each other



Social Bubbles

- Bubble conditions
- → the interest to foster bubbles obviously rests upon the claim that such **bubbles are good** (unlike financial bubbles) – at least in the long run, in that they create long-lasting innovations and infrastructures. Even though they result in financial blows for some, they can result in necessary innovations and infrastructures ...

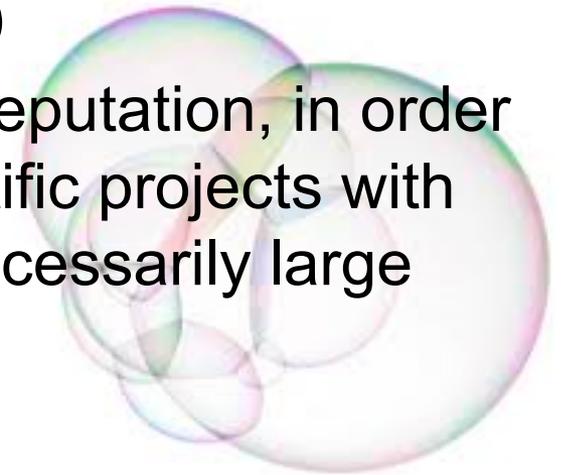


Literature

- Gross, D. (2007). *Pop! Why Bubbles Are Great For The Economy*. New York: Collins
- Perez, C. (2002). *Technological Revolutions and Financial Capital. The Dynamics of Bubbles and Golden Ages*. Cheltenham/Northampton: Edward Elgar
- Perez, C. (2009). The double bubble at the turn of the century: technological roots and structural implications. *Cambridge Journal of Economics* 33, 779–805
- Gisler, M. and D. Sornette (2009, 2010, 2011); div.

Social Bubbles

- We go as far as to claim that **bubbles are needed** since it is during bubbles only that people (individuals and companies) take inordinate risks based on expectations for the outcomes (utopian goals in science)
- Ready to invest their time, money and reputation, in order to engage in major and long term scientific projects with potential large social impacts but not necessarily large financial returns



Social Bubbles

- It is worth understanding what causes bubbles (dynamics of such mechanisms), for this might show governments a.o. how to catalyze **long-term thinking** that is increasingly absent from their own investment strategies and those of the private sector.

Scheme

	Social Bubble	Finance Bubble
Expectations / Incentives	Return lies in scientific/ technological/social impact	Monetary return
Benefits	Beneficial in the long-run: creating innovation; building new infrastructures	Beneficial in the short- term expected; devastating end most likely
Seen as	Good bubble	Bad bubble

Case study

- **The Human Genome Project
(1990-2000)**



The Human Genome Project: Overview

- International Human Genome Project (HGP) was effective between 1990 and 2000; it declared its official termination in 2003
- Its primary goals were to identify all the approximately 20,000-25,000 genes in human DNA, determine the sequences of the 3 billion chemical base pairs that make up human DNA, store this information in databases, improve tools for data analysis



The Human Genome Project

- Argumentation in favor of the project:
- Substantive long-term impacts on basic science, on biotechnology and on pharmaceutical industries
- Powerful when it comes to detect disease genes
- Personalized medicine
- Walter Gilbert expressed his confidence that “a human genome project [. . .] would produce tremendous benefits, not only for genetic and molecular understanding but also for medicine.”



The Human Genome Project: Initiation

- Meetings in Alta and Santa Cruz, 1984 and 1985
- Attended by a large group of high-ranking scientists from the U.S. and the UK (Walter Gilbert, Leroy Hood, John Sulston, Robert Sinsheimer, etc.)
- Decision to develop systematically a genetic linkage map, i.e. a physical map of ordered clones
- Main arguments: investing into research on genes, track down diseases and develop potential cures

The Human Genome Project: Actors

- 1986 Office of Health and Environmental Research at DOE (C. DeLisi) starts Human Genome Initiative; funded internally and by Congress, supported by the Health and Environmental Research Advisory Committee (HERAC)
- 1988 NIH establishes Office of Human Genome Research
- → National Center for Human Genome Research, under James Watson
- Watson declared official start of project as of October 1990
- → NIH established as the lead agency
- Budget totaling about \$85 million in 1990

The Human Genome Project: Actors

- Walter Gilbert (Harvard) was one of the principal spokesmen for the Genome Project; proving to be an articulate visionary, transmitting excitement to other molecular biologists and to the general public
- Policymakers eventually ratified the judgments of the scientists, providing funds to get the project going
- Great support within the scientific community in biology as well as the government and the public
- Circulation in the public, provoked vigorous debate

The Human Genome Project: Turning Point

- Dispute over patenting of genes within NIH pivotal for change
- J. Craig Venter initiator of the discussion
- In 1992, he was being offered \$70 million over seven years by the investment company HealthCare Investment Corporation to establish “The Institute for Genomic Research” (TIGR), a nonprofit research institute
- Sister company “Human Genome Sciences” would commercialize the products developed by TIGR (requested first/exclusive access) → new model

The Human Genome Project: 1992–

- After 1992 biotechnology firms started to compete directly with the public project
- Venture capitalists started to show interest to fund genomic research (therapeutics; sequencing)
- The venture capital community was “getting very excited, all the pieces are coming together” (Mark Levin, cited in Anderson, 1993/259:301)
- Genomics evolved from non-profit and governmental research into a hybrid public–private endeavor

The Human Genome Project: 1992–

- Attitude not only changed on the private side, but also among scientists
- One reason: NIH and DOE budget remained relatively low provoked delays in the effective support of ongoing research.
- Furthermore, these years were characterized by shifting from mapping to sequencing, and industry was perceived as being best at that kind of factory-like production

The Human Genome Project



- Example of James Watson:
- Resigned in 1991 over a public–private issue
- Now argued that the benefits of industrial participation far outweighed the potential drawbacks
- Large-scale sequencing demanded for academic-industrial partnerships in order to produce technology developed in university labs so far
- Set up a company from collaboration of public and private laboratory, with the goal to develop high-speed sequencing technology

The Human Genome Project: Take off

- Agencies outside the U.S. took on prominent roles, namely Britain's Wellcome Trust
- Consequently, in October 1993 Francis Collins, head of NCHGR, requested more money on the basis that the budget had not increased as fast as was initially recommended
- Argument: medical benefits would be delayed, loss of U.S. biotechnology
- In 1993, private funding reached parity with government funding (US); and raised faster

The Human Genome Project: Take off

- 1995: Venter was perfecting his ‘whole-genome shotgun’ approach
- 1997: new status of NCHGR, now NHGRI (National Human Genome Research Institute) within NIH → begins to accelerate effort, concentrating on six distinguished projects in sequencing
- 1998: Collaborators at WashU (St. Louis), funded by NHGRI, and the Sanger Center (Wellcome Trust) complete the deciphering of the *nematode Caenorhabditis elegans*
- 1998: Venter founded Celera Genomics; tackled new time horizon (3 yrs)

The Human Genome Project: Take off

- → The UK Wellcome Trust doubled its funding to prevent the sequencing project from falling under control of a private company
- US reorganization of public program, increased pace by reorienting their schedule (to reassure Congress)
- Accordingly, the U.S. Government pumped money into the sequencing side of the NHGRI
- Venter teamed up with a publicly funded team (UC Berkeley) and by September 1999 announced to have carried out the sequencing of the fruit fly *Drosophila melanogaster*

The Human Genome Project: ... And Landing

- June 26, 2000, U.S. president Bill Clinton and UK Prime Minister Tony Blair declared the program as terminated (even though a rough draft of the human genome was at hand only)
- February 2001, Celera and HGP scientists published details of their drafts (in *Science and Nature* respectively, describing the methods used and offering analysis of the sequence)
- Improved drafts were announced in 2003, filling the gaps

The Human Genome Project

- Anticipations of the commercial and medical applications of the HGP turned out to be highly inflated
- Set of technologies that can be used for diverse purposes in biomedical research is here
- Results from the genetic mapping and sequencing effort are a starting point for future research in biology and medicine

The Human Genome Project: A Social Bubble - Conclusion

- The race and mutual interactions between the public and the private Genome initiatives helped to weave a network of reinforcing feedbacks that finally led to a draft of the Human Genome, years earlier than planned, and not – as is sometimes suggested – thanks to the increased speed of the underlying technology involved in sequencing



Social Bubbles: Components

	Finance	Social
Displacement	Changes in economic circumstances create new and profitable opportunities for certain companies	Scientific options loom on the horizon, individual or groups believe to be ready for it, whatever the risks and consequences
Euphoria or overtrading	A feedback process sets in whereby rising expected profits lead to rapid growth in share prices	Rising expectations toward scientific outcomes among different supporters of the project → leads to feedback process

	Finance	Social
Mania	The prospect of easy capital gains attracts first time investors and swindlers	Atmosphere in which actors undertake large risks, ready to invest Prospect of capital gains attracts different players; esp. capital ventures and other businesses Credit creation via private (and public) investments
Distress	Insiders discern that expected profits cannot possibly justify the now exorbitant price of the shares and begin to take profits by selling	Change of initial structures and plans, amplification of schedule
Revulsion	As share prices fall, outsiders run for the exit, causing a bubble to burst	Program termination; “adjustment of promises”