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The Trough Of Despair And The Slope Of Enlightenment: Gartner's Hype Cycle And Science Fiction In The Analysis Of Technological Longings.

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Abstract

Futurology and computing technologies have a history of over-inflated claims and fast-changing meanings. That there is a time-lag between computing research and development, and the greater public awareness of those technologies, is well understood in the scientific research community, but less so by those who come upon new technological delights as if they were a-historic productions. There are several methods to map these changes in order to explain how one might gauge the real possibilities of a particular new technology, rather than the visionary potentials. Science fiction gives us useful snapshots of contemporary ideas of technology trajectories, and timelines of technological development help us to better understand the historical basis of a particular technology. Gartner's hype cycle is a diagram which maps emergent technologies, labels and trends against actual take-up and development. Using the examples of virtual reality and cloud computing this paper explores ways of making better predictions about the implications of technological change.

Keywords: Adoption, Prediction, Gartner's Hype Cycle, Science Fiction, Timelines

1.0 Introduction

How can we evaluate the usefulness of possible future technologies? A common problem both for business (and for an individual) is to decide when, if ever, to adopt a new technology, or which version to choose, and what effect such an adoption might have on the business or organisation. Committing to the wrong type of technology, or committing too soon, can be very risky for an organisation, as in the cases of the disastrous implementations of Enterprise Resource Planning systems in the 1980s (Davenport, 1996; Holland, 1999), or the problems which resulted for early adopters of certain e-business models in the late 1990s (Howcroft, 2001; Rosenbloom, 2002). For the individual, dedicating a collection of music to a form which becomes obsolete is a frustrating experience which many of us have lived through. Providing a dedicated format for an e-book can be both a commercial money-spinner, and at the same time, a path to both obsolescence and falling profits.

The motivations for this exploration of evaluation and prediction are as follows. For some years I have taught an honours module in critical aspects of Information Systems with themes such as failure, evaluation, security and surveillance, and aspects of socio-technical theory. During the period of the UK ID project (2000-2010), a useful and evolving educational case study, I became interested in whether or not biometrics were a feasible technology, given the political rhetoric associated with the imperative of their use for global security. There were several reasons at that time why the use of, say, iris-recognition as part of the UK-wide ID

project, might not have actually worked in practise, given the problem of creating iris-reading technologies (the danger of burning the eye using the then contemporary technology was of some concern); the statistical nature of biometric recognition processes and the implications for the incorrect recognition of an individual, still an on-going issue (Biometric Recognition, 2010); the lack of infra-structure for storing information for (global) identification purposes; the nature of failure in large-scale public sector IS projects; the cultural resistance to the use of ID papers in the UK prior to and after the second world war; and so on. I introduced film clips (mainly from Speilberg's *Minority Report*, as discussed below) and readings (Orwell's *1984* is a familiar topic in secondary school English syllabuses) in my lectures and tutorials as a starting point for discussion around these topics, trying to get students to focus on untangling the effect that predictions have on emerging technologies, as well as encouraging the exploration of social process. In addition, as noted below, I have introduced the drawing of timelines, and Gartner's Hype Cycle, a diagram which sets out to graph the rise, fall and possible adoption of emergent technologies, and ideas, in order to help students think more clearly about the problems of prediction.

The emergent technologies discussed in the paper are Virtual Reality and Cloud Computing, amongst others. The methods that may help take the guess-work out of evaluating new technologies are presented in the following order: Science Fiction and its role in design; Timelines which detail the parallel routes of research, development and take-up; and Gartner's Hype Cycle. As with all models and abstractions, there are drawbacks to these methods, some of which are detailed in the paper below.

2.0 Science Fiction

The genre of Science Fiction (SF) explores possible future uses of technology and is often concerned with prophetic warnings for our times about the misuses of science. Common tropes include post-apocalyptic survival, robots and automation as threats or helpmates, or as part of a human/machine cyborg evolution, space and time travel and their associated paradoxes, other life forms and climactic battles, and so on. SF has expanded since its beginnings in the mid-19th century to cover a range of interests and themes, and some texts or film in the sub-genre of fantasy, for example now contain little or no science or technology, or are oblique commentaries on our own history of technological adoption (see Terry Prachett's *Discworld* series) (sfsignal, 2011). The first authors to have their work categorised as SF are Jules Verne and H.G Wells, who both imagined futures premised on state-of-the art science and technology, though Verne's writings, which he called 'scientific adventures', are not always regarded as SF. Well's prophetic SF writings include the *Time Machine* (1895), *The War of the Worlds* (1898) and *The First Men in the Moon* (1901); Verne's books include *Journey to the Centre of the Earth* (1864) and *From the Earth to the Moon* (1865).

In France, a perhaps less-well known author and illustrator of this early period is Albert Robida, who wrote a trilogy of futuristic novels in the 1880s and provided amazing drawings for a number of magazines where he juxtaposed contemporary life at the end of the 19th century with a future filled with technologies based on the current state-of-the art examples of radio, rockets and hot air balloons, and steam engines. Robida's ideas encompassed solo rocket-based flying machines, the use of personal radio on the metro, and the Téléphonoscope, a flat screen which provided 24 hour coverage of news, plays, courses and

Skype-like communication (Willems, 2004). His writings and illustrations provide a useful source for today's steam-punk enthusiasts.

That science fiction, in all its forms, such as book, comic, film and multi-media game, is influenced by and has an influence on the design of technology and information systems is well-established (Kirby, 2003; Dourish, 2009; Kirby, 2010; Bassett, 2013). Kirby, for example, critiques the popularising of science through film, and notes the growing use of scientific consultants on set, not to ensure that the science in SF film is more 'real', but rather to help with the plausibility of the scientific scenarios (Kirby, 2003). Dourish and Bell discuss the influence that the television serials *Doctor Who*, *Star Trek* and *Blake's 7*, amongst others, have had on the discipline of ubiquitous computing and human-computer interface design (Dourish, 2009). Ubiquitous computing (also called pervasive computing) investigates "machines that fit the human environment instead of forcing humans to enter theirs" and is concerned with virtual reality (VR) and associated research topics such as 3D simulations, avatars, online immersive games and haptics (wearable computing technologies). These technologies are the stuff of cliché in science fiction. Science fiction is a useful means of critiquing contemporary society, and aspects of technological incursion into work and everyday life are found in the work of several authors. In particular, a strong SF trope is that of the individual pitted against a merciless bureaucracy, whose power is underpinned by novel forms of computer-based control, and whose all-seeing IS-enhanced surveillance harks back to Benthem's Panopticon design and Orwell's *1984* (Bentham, 1798; Orwell, 1949; Dourish, 2009; Bassett et al., 2013).

Science fiction writings have been the basis for a number of films, a number of which use the writings of Philip K. Dick (1928 - 1982). The hugely popular *Blade Runner* is a reworking of Dick's *Do Androids Dream of Electric Sheep* (1968), a dystopic novel of a world without animals, and illegal android replicants. The look of the Blade Runner city owes much to the viewer recognising one of the earliest SF films, Fritz Lang's *Metropolis* (1927), which in its art work relies on the contemporaneous ideas of Bauhaus architects manifest in the American skyscraper. Metropolis is itself a critique of Taylorist management methods and re-imagines automated humans, following Karl Čapek's play R. U. R., in which the word robot is first used in English (Čapek, 1925). The film *Minority Report* (2002), directed by Stephen Spielberg, is based on Philip K. Dick's short story of the same name, published in *Fantastic Universe* in 1956. The story is one of a security official who becomes a wanted man, after a pre-cog predicts the strong possibility that he will murder someone he has never met; on the run the hero finds himself locked out of access to every-day life, and the security areas he needs to investigate, as his status is changed in the centralised information system. Spielberg designed the 'future technologies' for the film in consultation with philosophers, scientists and artists. In Rothkerch's interview, published in salon.com some of these 'futerists' explain how they invented a plausible 2054 in which to frame the narrative (Rothkerch, 2002).

In *Minority Report* we see examples of the following technologies: (i) hand-controlled visual displays where images and data are moved across transparent screens at a distance (like the Wii); (ii) iris recognition at metro stops and in the mall, which tailor adverts to an individual as the hero flees from the police – an example of biometric authentication; (iii) electronic newspapers which are continuously updated with videos of the latest news item; and, of course, (iv) jet packs and mag-lev cars (remember Robida's flying machines?) Another less plausible technological advance displayed in the film is the uploading and storage of a human

in digital form, usually to allow extended life or immortality (an artificial intelligence premise often found in SF, as in the *Culture* series of Ian M. Banks), here as means to imprison possible criminals before their criminal acts can take place.

Much can be said about hindsight and the predictions of science fiction that did not work (Westfhal, 2011), but the point here is not to think that SF is a predictor of technological adoption or that all predictions in SF will, or necessarily should, happen. Rather it is to use SF to show the socio-technical processes in play in the emergence of technologies, the extent to which we can choose not to use a particular technology, and further, to try to bring a more measured approach to the immediate over-enthusiastic or doom-laden responses to the new.

3.0 Timelines – learning from history

A timeline can be a simple historical list of dates and important milestones. Here I consider the more complex timeline diagram which maps several different aspects of a technology's past, and in this way demonstrates, for example, the lag between research, development and public awareness (or acceptance). This is illustrated by the 'tire tracks' diagram of US government funding in research and development in IT, as shown in figure 1 (Benhamou, 2010). Stackelberg's paper on using timelines and exploratory forecasts in futures research states that timelines 'when used to lay out historical data and cycles, waves, logistic curves and other archetypal patterns along a common temporal scale, can provide a far deeper, more nuanced understanding of the dynamics of change' (von Stackelberg, 2008). One example of how a timeline can aid our understanding of a technology's practical, as opposed to potential, use is shown in figure 2. This timeline maps virtual reality research, technological underpinnings and research investment in educational technologies labelled 'virtual', demonstrating as a result, not only a lag between research and development, but also how often interest in VR has been linked to a particular technology and its emergence into general awareness, and how soon such interest falls away only to be replaced by a newly emergent technology, a renewed interest in VR and so on (figure 2). Thus VR is a phoenix-like technology, as defined by Gartner (Linden, 2003) and unlikely to be widely adopted anytime soon, as discussed in section 5 below.

The socio-historical analysis required in drawing such a timeline can demonstrate that what has been claimed as a new technology is, in fact, an older technology in new guise. The method may also bring to light important differences between previous versions and the newer forms of technology. This is a useful exercise to ask undergraduates to do, even if they find it difficult to draw a timeline. The gathering of related terms, the drawing up of more precise definitions, and detailing the underlying hardware and software, and particular groups, people and social processes, with associated dates for the chosen aspects, informs the discussion around creating the diagram. Luckily, there are always new technological terms available for such analysis.

An example of the application of this method is a historical analysis of Cloud Computing, where many have noted the similarity of time-sharing uses of mainframes of the 1950/70s, and the later model of networked and distributed computing of the 1980s. In 1964 the MULTICS operating system enabled time-sharing of processes and programs on a mainframe, thereby speeding up computing use for simultaneous users, and was often referred to as a 'computing utility'. In the 1970s IBM's VM (virtual machine) allowed

different virtual operating systems to run on the same underlying architecture, just as virtualisation is a feature of cloud computing today. In addition, the business model associated with the model of shared mainframe usage are similar to those of Cloud Computing; that of outsourcing services and infrastructure. This gives rise to similar problems now and in the past: how to charge for such services (and how to agree the measures of use), provide reliable and secure access, and apportion responsibilities (Greenwood, 2011).

4.0 Gartner's hype cycle

Gartner is a consultancy firm who provide information technology research for a range of clients across different sectors (Gartner, 2014). They have developed two graphical methods with which to display their analysis of predicted use of new technologies, namely the magic quadrant (not discussed here) and the hype cycle, which has been used to analyse new developments in a number of areas, including healthcare and education, and to identify possible new topics for information systems research (O'Leary, 2008; Bresciani, 2009; Gartner, 2014). The following discussion is based on Linden and Fenn's *Understanding Gartner's hype cycles* report of 2003 (Linden, 2003).

Gartner's hype cycle gives a visual representation of the first 3 stages of a technology life cycle, beginning with a 'technology trigger' and the talking up of a new product, and ending with the possible adoption of the technology by over 30% of the appropriate community. As such the hype cycle does not try to explain diffusion and adoption, which means that it is unlike the other technological life cycles which are found in a number of diffusion theories for products, technologies and innovations (Rogers, 1962; Routley, 2011).

There are 5 lyrically named stages, in many cases self-explanatory, to the S-curve which makes up the hype cycle diagram (see figure 3 below). These are as follows: (i) the technology trigger – the point at which a new technology emerges into greater public awareness; (ii) the peak of inflated expectations – which marks the first sightings of negative reports; (iii) trough of disillusionment – here the technology may slide off the diagram altogether, at maximum negative press or complete lack of public interest; (iv) the slope of enlightenment; and (iv) the plateau of productivity. This is a very persuasive image of technology development which recognises the talking up of the latest big thing, and the deflation of expectation which comes with time and further scrutiny, before pragmatism wins out and the technology is either abandoned or becomes more widely used. In fact, Gartner present us with a cluster of associated technologies on one diagram, each with a different position along the curve and with a related prediction of time to plateau status (figure 4). On the Gartner web-site, the diagram provides a quick way to find more about each of these technologies; as the user passes the cursor over each dot a window of related information opens beside the diagram.

Tracking a particular technology over time, and its changing position on a hype cycle, illustrates the changing nature of technology adoption, and the need to revise earlier estimates of the time-scale or plausibility of adoption. For example, Cloud Computing was introduced into the emerging technologies report of 2008 (figure 4) and was predicted to be at the plateau in 2 to 5 years, that is by 2013; by 2010 it was given a separate hype cycle, with a cluster of cloud-related technologies such as dedicated email services and virtualisation. By

2012, Cloud Computing was heading for the trough of disillusionment, with a growing negative press, and the time to full adoption was changed to being between 2014 and 2017. Since it has not yet fallen off a hype cycle, and it seems that there is a now a more pragmatic response to using Cloud Computing, and the plateau of productivity will be reached, as more recently predicted, in a few years' time. Note, however, that in the previous 6 years a number of changes have occurred to the definition and purposes of the term 'Cloud Computing', as well as the emergence of a number of related (but differentiated) technologies that may themselves either disappear or turn up in another guise on a different hype cycle (see van Lente et al. for further analysis of particular technologies and their hype cycles (van Lente, 2013)).

Gartner's hype cycle was first developed in 1995 and is based on Fosdick's (1992) general observation that for the IS manager the life of a new technology has three main phases: it begins with a hype phase, when media reports and vendor advertising bring a technology to wider public attention, prior to an early adopter phase, followed by a maturity phase. Though this observation cannot be empirically validated, in Fosdick's 1992 paper he states that "the histories of prominent software technologies over the past dozen years tend to substantiate these assertions" and notes that technological adoption is as much a sociological phenomenon as about the technology (and is hence an early proponent of socio-technology theory). Note that Fosdick does not allow for non-adoption after disasters in the early adoption phase, or immediate take-up. In discussing where hype comes from, Fosdick cites the financial gains to be made by the IS industry in talking up novel products (which may be older technologies in new garb – see the historical roots of Cloud Computing discussed above) and the self-interest of technologists and vendors in fuelling such hype (Fosdick, 1992).

Academic researchers also talk up new products or areas of research in order to further their interests (and status), feeding new ideas into public policy and funding streams. This is understandable – we are attracted to playing with shiny, new toys. This playfulness is an important part of our exploration, understanding and inventing of the world and acts as a means to escape into dreams and fantasy, as noted above in the case of SF and design. Kurt Vonnegut, whose work extended the SF genre in the 1950s and 1960s, stated in the posthumously published collection of his lectures and essays, *Armageddon in Retrospect*:

> And, if you'll investigate the history of science, my dear boy, I think you'll find that most of the really big ideas have come from intelligent playfulness. All the sober, thin-lipped concentration is really just a matter of tidying up around the fringes of the big ideas. (Vonnegut, 2008)

Technology life cycles in general are rarely based on testable data, and Gartner's hype cycle is no exception. The presentation of the graph gives a quasi-scientific and easy to read image, which summarises a longer report, also based on the subjective views of the Gartner consultants and researchers. It is difficult to assess the extent to which users of Gartner's reports read all the details, or only look at the diagram to gauge whether or not to adopt a technology. However, Linden and Fenn in their 2003 report, also explain that not all adoption stories fit the Gartner hype cycle. A technology may fall off the diagram altogether, or, having been abandoned, remerge in a different guise at a later date, as Phoenix-like technology that yet awaits adoption. A socio-historic analysis of the 3 cycles of responses to new technologies (multi-media, web pages, virtual learning environments) in the research, development and implementation of educational technologies in higher education from 1980-2008, shows a common dystopic/utopic response to the emergence of a new technology, a

related tranche of funding, followed by adoption and falling away of interest, which has some similarities to this phoenix-like classification (Michaelson, 2011). That this long-term cyclical process continues is demonstrated by two more recent phases: (i) in 2005-2010, responses to virtual worlds such as Second Life and their possible uses in higher education (Michaelson, 2010b); and (ii) the current interest in massive online open courses or MOOCs (BIS, 2013). Again, these more nuanced details about a technology require more than a quick glance at the current diagram.

In addition, there are technologies which have immediate and all-pervasive take-up, and some which have several peaks and troughs (Routley, 2011). A further possible trajectory includes the technology which is promoted by some specific group of technologists or academics, for example an infra-structure technology that may underpin opportunities for business, but is not of direct interest to businesses. In the early 1990s, ATM (asynchronous transfer mode) which was first defined in the 1970s, and championed by the telecommunications industry, was regarded by many as a technologically superior communications protocol to that of the internet protocol (IP). However, though it was optimised for voice and video communications, ATM was adopted only in a part of the internet infrastructure, remaining widely used in broadband access lines, including WAN links inside telephone networks, and hence the preserve of communications technology experts (Steinberg, 1996; Tanenbaum, 2010).

According to Tanenbaum, ATM supporters promised "… a network technology that would solve the world's telecommunications problems by merging voice, data, cable television, telegraph, carrier pigeons, tin cans connected by strings, tom toms, and everything else into an integrated system that could do everything for everyone"; and his reasons for the failure of ATM to be universally adopted were "... bad timing, technology, implementation and politics" as is the case with many other promising technologies (Tannenbaum, 2010, p. 249). These factors may be detailed in the Gartner reports, but are not fully realised in the hype cycle itself.

5.0 Conclusions

Technological longings manifest themselves as an overstating of the possibilities of the new. Perhaps because we do not fully understand the complexities of computer systems and have not yet fully realised a way to talk more realistically about these complexities, there is a tendency to over-enthuse or dread the effect of these as yet-untested novelties. Wertheim has documented the human need to see transcendence in cyberspace (Wertheim, 1999), and science fiction is a genre which allows us to play out these imaginings of technologies and transcendence, allowing the exploration of possible futures and sometimes influencing specific design choice/s and research themes in information systems. Predicting the future uses of computing technologies which have a history of over-inflated claims and fast-changing meanings is very difficult, as with most predictions. The time-lag between computing research and development, and the greater public awareness of those technologies that are actually used, is well understood in the scientific research community, but less so by those who come upon new technological delights as if they were a-historic productions.

In this paper, I discuss several methods which map these changes in order to explain how one might gauge the real possibilities of a particular new technology, rather than the visionary potentials. As noted above, science fiction provides a useful snapshot of contemporary ideas

of technology research, but the lag between technological change and the production of science fiction artefacts is not fast enough to aid business, or individuals, in the present. In addition, SF as well as informing design in computing, also informs the more general utopian/dystopian aspects of technological longing, adding to general beliefs (or visions) of disruptive technologies and artificial intelligences. Timelines of technological development help us to understand the historical basis of a particular technology, and hence go some way to helping us make better predictions about the usefulness of new technologies. Gartner's hype cycle is a diagram which maps emergent technologies, labels and trends against actual take-up and development, in an attempt to bring back the possibilities of the new into the realm of the everyday. All of these methods can provide a means to a more measured response to the latest big thing, and help illustrate the social dimensions of novel technologies, and go some way towards a more realistic appraisal of the predicted uses of the new.

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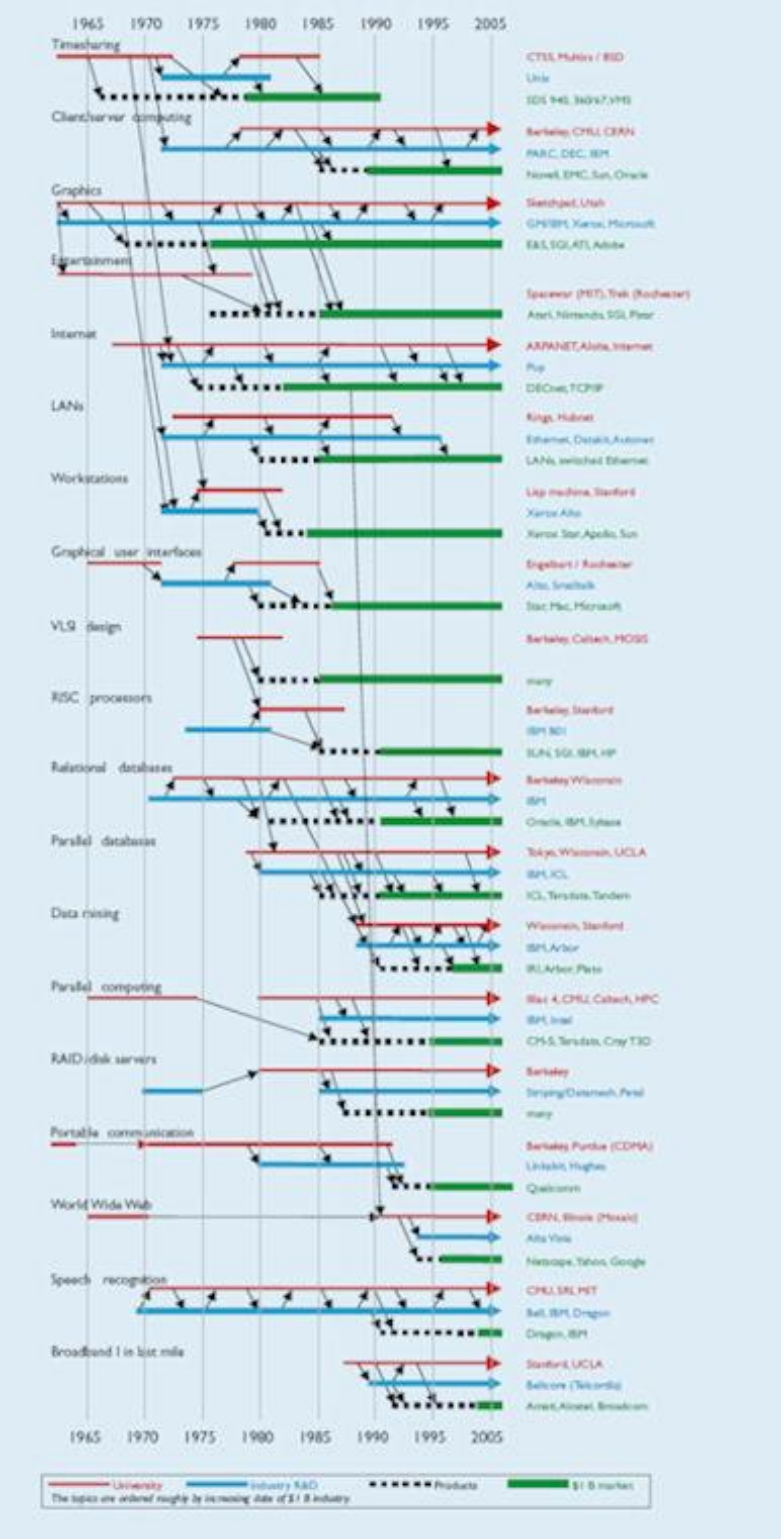

Figure 1: 'Tire tracks' diagram (Benhamou, 2010)

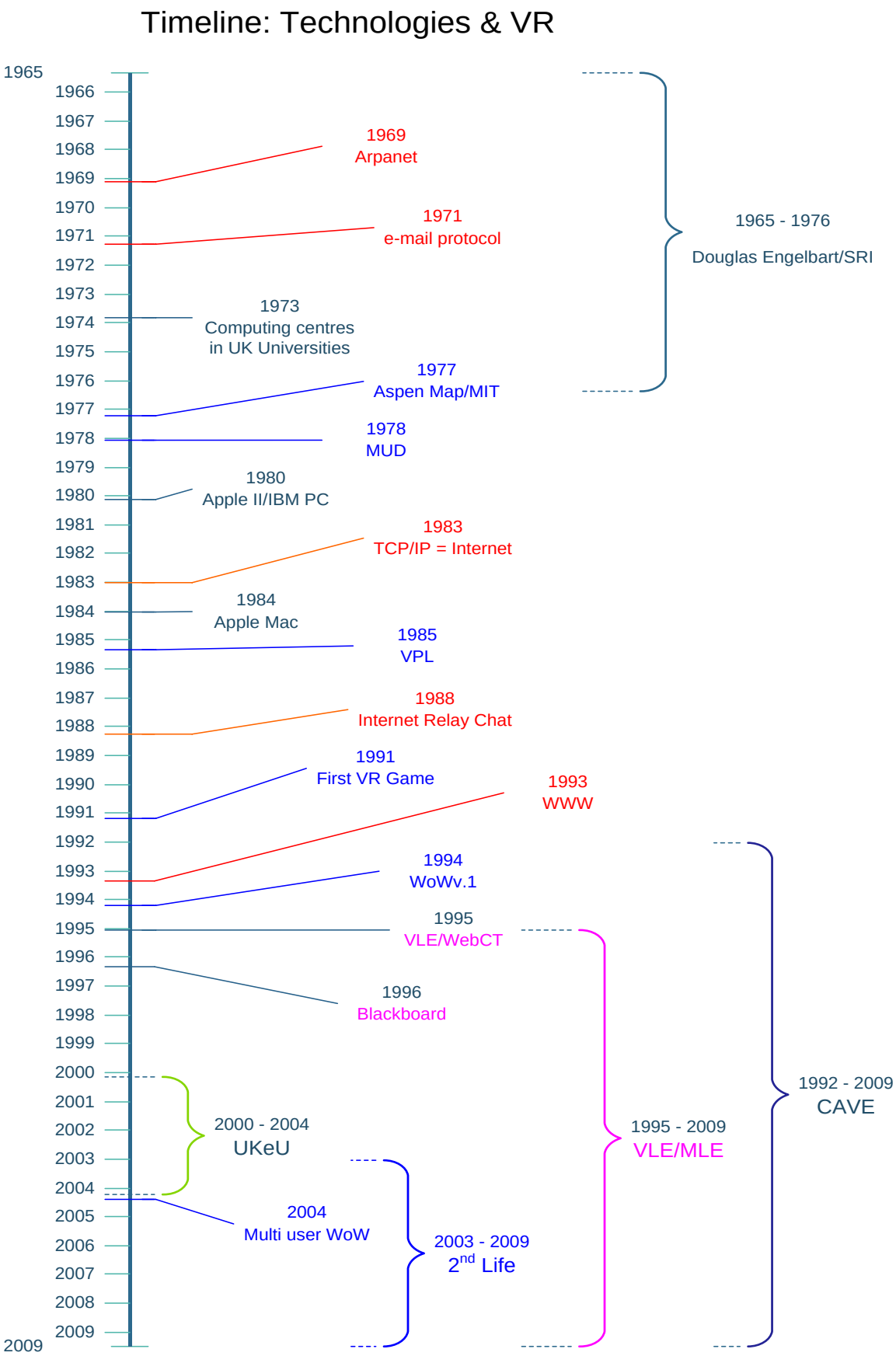

Figure 2: Virtual Reality and the university (Michaelson, 2010a)

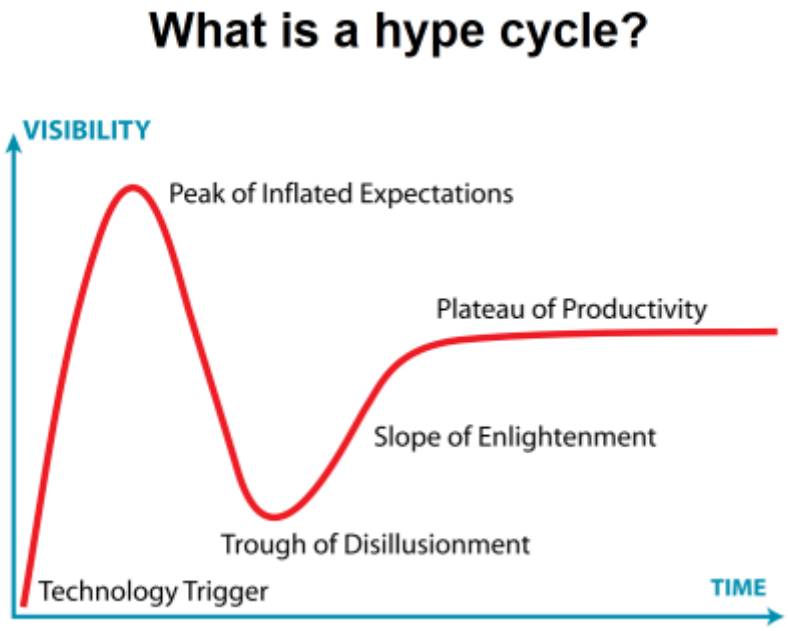

Figure 3: Understanding Gartner's Hype Cycle (Linden, 2003)

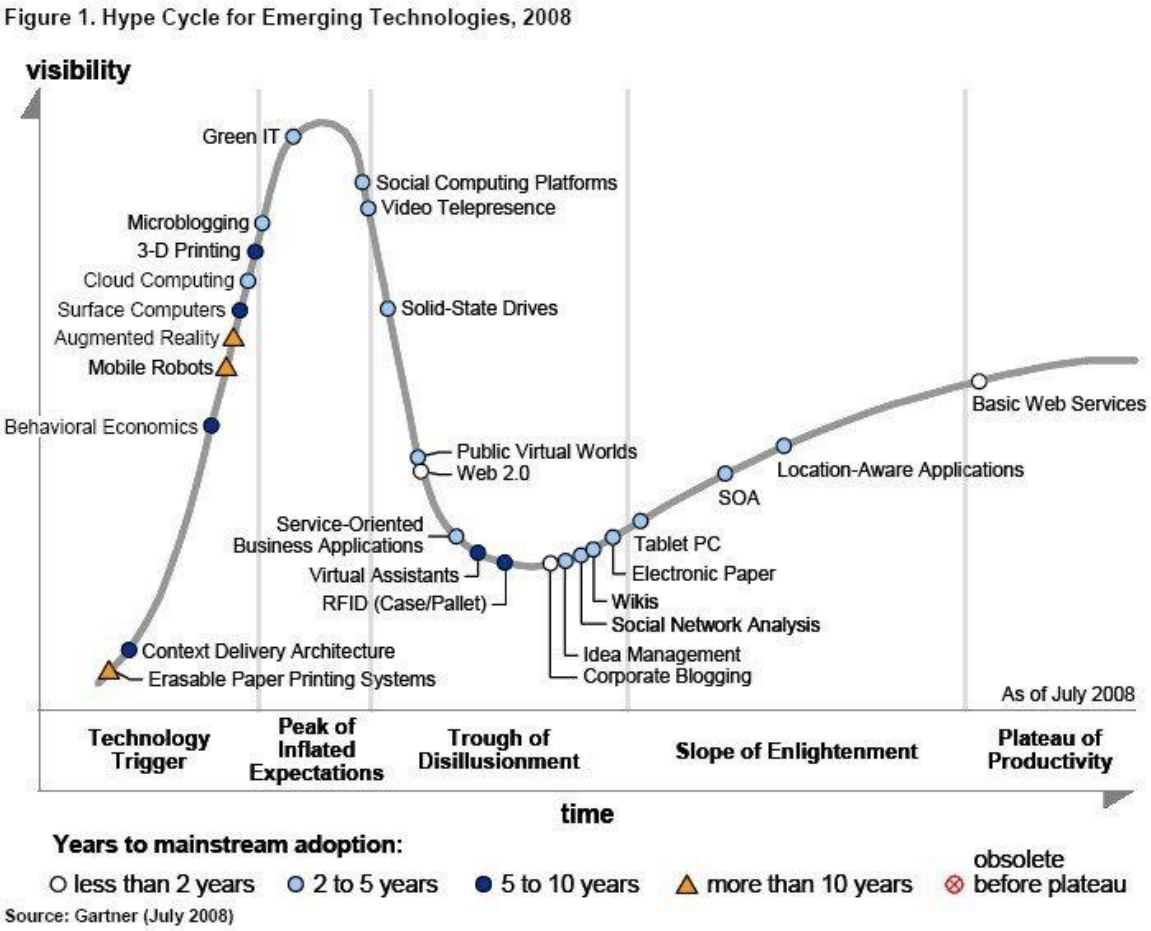

Figure 4: Cloud Computing in Emerging Technologies Hype Cycle, 2008