As a Utility – Metaphors of Information Technologies

Maria Lindh, University of Borås

Building on conceptual metaphor theory, this article investigates and argues the importance of the utility metaphor in shaping information technologies. The document study reveals that the utility metaphor has been evoked in different shapes and forms continually since the late 50s relating, for example, to concepts such as Time-sharing, Computer networks, The computer grid, Utility computing, and – the contemporary metaphor – Cloud computing. The metaphor has had different roles – sense-making, constitutive, restrictive, or as a tool of power – and played a part in narratives that emerged during the time periods studied: centralised *versus* decentralised, control *versus* flexibility, standardisation *versus* specialisation, commercial *versus* non-commercial.

Keywords: cloud computing, conceptual metaphor theory, information technology, perceptions, social shaping of technology

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> *As I stood there surveying the data center . . . I realized that what I was standing in was a prototype of a new kind of power plant – a computing plant that would come to power our information age the way great electric plants powered the industrial age. Connected to the Net, this modern dynamo would deliver into our businesses and homes vast quantities of digitized information and data-processing might. It would run all the complicated software programs that we used to have to install on our own little computers. And, just like the earlier electric dynamos, it would operate with an efficiency never possible before. It would turn computing into a cheap, universal commodity.*
>
> *"This really is a utility," I said to Sullivan.*
>
> *He nodded, grinning. "This is the future."* (Carr 2008, 5)

The passage is from the prologue of Carr's *The big switch* (2008), where the shift of computing into cloud computing is compared with the transformation of decentralised to centralised production of electricity. The starting point of this article is the realisation that such descriptions of cloud computing – as a utility – seem to resonate with a multitude of historically influential descriptions and visions. It seems that when new forms of information technology were developed, *the utility metaphor* was revisited. Therefore, it can be contended that the dramatic description of cloud computing as a utility is not as fresh as it may appear. Rather, it can be seen as a new variation of a favourite metaphor. The article makes an inventory of these different variations and discusses the longitudinal development with regard to its implications for society.

In line with Sturken and Thomas, I argue that "[v]isions of new technology are highly productive – they impact how technologies are marketed, used, made sense of, and integrated into people's lives" (2004, 3). The focus is on how the utility metaphor is used to limit the range of interpretation, thereby leading, perhaps misleading, public discourse on information technology. The main thrust of my argument is that the utility metaphor continuously, throughout modern history, has been used as an instrument for downplaying the stakes involved when new information technology is introduced. In other words, the utility metaphor tends to signal the introduction of non-invasive, essential, politically unobtrusive and neutral technology. Through a historical review – in managerial and business related areas – I will identify and discuss various forms of usages of the utility metaphor in connection with visions of information technologies.

This study serves as a continuation and a complement to a research tradition that combines studies within the *social shaping of technology* (SST) – represented by Winner (1980), among others – and the study of information technology related metaphors – represented by Abbate (1994). Her unpublished article is the only previous research found similarly investigating the utility metaphor.

In this study, I utilize *conceptual metaphor theory*, developed by Lakoff and Johnson (2003). Accordingly, I see metaphors as powerful instruments in the creation of social realities and claim that the metaphor of information technologies – *as a utility* – has been used continuously since the late 50s by both scholars and professionals. I pose the following research question:

> *What different aspects of information technologies are made visible or hidden by the neutral technology metaphor "as a utility" and what does this indicate?*

Strict technological aspects are in most respects omitted. The article builds on a document study, where the use of the utility metaphor – information technologies compared with electricity or other utilities – has been analysed.

Metaphor properties

Metaphors are vague and flexible in that they tolerate more than one use or a specific understanding "both over time and across various topics in a society, yet at the same time they are robust enough to maintain certain implications" (Hellsten 2002, 3). They are often used to convey images and are therefore both "normative and cognitive structuring devices" (Wyatt 2004, 245).

Metaphors help people comprehend new phenomena and thus to *make sense* (e.g., Hellsten 2002; Markham 2003; Wyatt 2004). They can also become "self-fulfilling prophecies" (Lakoff & Johnson 2003, 157). Accordingly, metaphors can be understood as *constitutive* (e.g., Hellsten 2002; Sturken & Thomas 2004). Hellsten claims "metaphors are constitutive of certain views of the world" (2002, 3) and can guide future actions. As such, metaphors are political devices since they "not only help us to think about the future; they are a resource deployed by a variety of actors to shape the future" (Wyatt 2004, 257). Wyatt exemplifies: "Hackers draw on metaphors that convey the importance of transparency and the pleasures of puzzle solving, whereas computer security experts deploy metaphors that invoke fear, anxiety, and apocalyptic threat" (2004, 244)

Abbate (1994) discusses how the cultural identity of new technologies is constructed through the use of metaphors, by focusing on specific characteristics of the technology. Obviously, metaphors "can also mislead" (Wyatt 2004, 245), emphasizing certain aspects while omitting others. Metaphors can, in this sense, be *restrictive*.

Furthermore, metaphors are *tools of power.* The use of certain images reveals different actors' thoughts and intents. The fact that metaphors can direct human perception in certain directions further emphasizes their power (Wyatt 2004). Andrade explores how metaphors of the internet have shaped, and will continue to shape, information and communication technologies. He demonstrates how metaphors have been "driving the incessant pace of technology, contributing to its social acceptance and implementation" (2010, 121). Metaphors are not innocent, but connected to power and control. Actors can, by the control of the use of metaphors, "shape the discussion to their own advantage" (Larsson 2012, 618). In line with Larsson's argument, Leong *et al.* claim that metaphors are representations of political, social, as well as cultural norms and values, and therefore not used in a void (2009, 1274).

On the one hand, metaphors can be described as socially constructed, used to communicate and persuade. On the other hand, the roles of metaphors can be described as sense-making, constitutive, restrictive and as tools of power. These roles will further be elaborated in the concluding discussion. The most used metaphor theory is Lakoff and Johnson's *conceptual metaphor theory*, which is focused in the following section.

Conceptual metaphor theory

Using metaphors is more than manner of speaking or of language; it also reflects human experience in every sense. Lakoff and Johnson (2003) are interested in what they call *metaphorical concepts*. When describing a phenomenon, it is not always possible to use an exact phrase. Even if most metaphors "can be *experienced* directly, none of them can be fully comprehended on their own terms [but] in terms of other [kinds of] entities and experiences" (Lakoff & Johnson 2003, 178). One of their examples of conceptual metaphors is the expression "Argument is war" (Lakoff & Johnson 2003, 5), building on experiences of argumentation as fearful struggle. If argument is war, it is therefore logical to claim, "I won that argument!" (ibid.) adhering to the image of war. Consequently, a myriad of metaphors are part of our everyday speech and, as such, influence how we perceive things.

We tend to make sense of diffuse phenomena, such as "human emotions, abstract concepts, mental activity, time, work, human institutions, social practices and even physical objects that have no inherent boundaries or orientations" (Lakoff and Johnson 2003, 178), by using metaphors to make them more specific and tangible. New information technologies are both physical and abstract phenomena and are often perceived as diffuse, provoking metaphorization.

There are good reasons for using different metaphors as a way of conceptualizing a phenomenon. Metaphors communicate by simplifying and exaggerating one specific dimension. Therefore, no one metaphor will serve all purposes. Any given metaphor will highlight certain aspects and disguise others. Furthermore, different metaphors may clash when seen in the light of each other. “To operate only in terms of a consistent set of metaphors is to hide many aspects of reality. Successful functioning in our daily lives seems to require a constant shifting of metaphors” (Lakoff & Johnson 2003, 222).

Sturken and Thomas (2004) argue that information technology metaphors are constitutive in that they determine understanding, lead the imagination and impact on society. Interestingly enough, metaphors relating to information technology often serve as precursors to the introduction and implementation of the technology itself. In this article I will primarily discuss the utility metaphor as promoting a view of technology as non-invasive and non-political, i.e., as neutral. Therefore, I will also analyse other neutral metaphors pertaining to technology. My argument is that neutral technology metaphors serve to offset potential criticism and resistance. Metaphors, such as “utility”, tend to hide or make less visible the political and social implications of new technology.

Technology as neutral

In his seminal essay *The question concerning technology*, Heidegger (1954) argues that humanity tends to develop technology under the misconception of being in control. Technology is perceived as objects, or tools, to be used by subjects. This notion, of technology as far from being a neutral tool, has been elaborated in diverse ways by different researchers. McLuhan (1964) famously announced that “the medium is the message” suggesting that the character of mass media technology has a stronger influence on society than the content itself. In a more dramatic integration of the ideas suggested by Heidegger (1954), Callon (1986) and Latour (2005) coined the concept “actant” to afford the analysis of the influence of things.

My perspective is inspired by Winner (1980) who queried, "Do artifacts have politics?" Winner confronts the idea of technology as neutral and argues that artefacts are always produced in societal settings and therefore become intertwined with existing power structures. The production and distribution of new technology, therefore, tend to become vehicles for political agendas.

In this article, I am interested in use of the utility metaphor as a way of intentionally or unintentionally disguising the societal and/or political aspects of information technology. Obviously, "utility" is only one of several metaphors that articulates technology as neutral. The most obvious and well-used and related metaphor is technology *as tool*. Hirschheim and Newman discuss this metaphor in relation to man *as craftsman* (1991, 38):

> *Technology is thought to be a tool in the hands of the workers. It is used when and where appropriate, to make their work more efficient and to raise the quality of life in general. The tool is of itself neutral, and can be used in many ways. Man is looked upon as a craftsman who scans his surroundings, choosing the most appropriate tools for the task at hand. The craftsman is skilled and can apply the tools to advantage. Should the tools be unsatisfactory, the craftsman can modify them or choose not to use them. . . . The relationship between craftsman and tool is that of master and slave.*

The metaphor suggests an "optimistic scenario" allowing the user of the tool the means to accomplish something (Hirschheim 1986; Hirschheim and Newman 1991). On the other hand, a tool incorporates a "fixed functionality" (Stevenson 2007), i.e., its use is strictly limited to particular tasks.

There are also metaphors that suggest neutrality by indicating problem solving. In line with Lakoff and Johnson (2003), Hamilton (2000) discusses attitudes and beliefs as effects of information technology metaphor use. Her findings show that there are two closely connected value-neutral tool metaphors within information technology discourse: *IT as solution* in relation to *organisation as problem,* and *IT as a form of surgery* in relation to “the organization as an entity which is *ailing*, *bloated*, or *ill*” (Hamilton 2000, 249). The solution metaphor is related to the utility metaphor since a solution will alleviate inconvenience and satisfy immediate needs. Someone else has already provided an answer, without any effort on the user’s side. The surgery metaphor is yet another close metaphor, allowing the actor to passively accept an intervention from someone knowledgeable enough to diagnose and prescribe appropriate treatment, without negotiations or discussions.

These different metaphors – *as a tool, solution*, and *surgery* – all indicate variations of technological determinism.

The utility metaphor

It is not the purpose of this article to define “utility”, rather I take an inventory of a multitude of usages. However, to give the reader a general sense of the flexibility of the meaning of the metaphor, I suggest the following ball park estimation building on Rappa (2004):

> *For a service to be regarded as a utility a combination of requirements have to be fulfilled; it is easily accessible, profitable, practical, functional, standardised and well adapted to its purpose. Public utilities are necessary services such as water, power, heating, electricity, telephone access and transportation.*

Rappa (2004) points out that the different characteristics of a utility derive from the different aspects of a service; some are generated through the customer relationship, others originate in technological or economic issues.

As suggested initially, Carr (2005; 2008) has made elaborate use of the utility metaphor. The central theme in Carr’s argument is that information technologies are increasingly becoming commodities. Nonetheless, the utility metaphor suggests a simplified viewpoint in which we can understand the complexities of cloud computing through our experiences with other forms of essential, unproblematic everyday technology. Carr has been criticized for making comparison between electricity and information technology, because of the asymmetry involved. Browning (2008) and Vandenbosch and Lyytinen (2004) point out that electricity is a homogenous product, while information technology provides a wide range of services. Furthermore, there is also a high degree of flexibility in production within IT, including user-generated content. Arguably, electricity constitutes a different kind of power, which is highly standardised.

Furthermore, Brynjolfsson *et al.* (2010) point out several differences between cloud computing and electricity, from technological and economic perspectives. For instance, they highlight that managing systems under change requires skilled, innovative personnel, and other types of information architecture, not just more nodes; centralised data centres save electricity at the cost of latency. Computing is not seen as a commodity but as constantly developing, due to innovation and co-invention. They also claim that there are no interchangeable service offerings from cloud providers: "bits of information are not electrons". Moreover, there are other types of security risks in cloud computing compared to electricity (Brynjolfsson *et al.* 2010, 33f). Obviously, metaphors tend to draw only on parts of the different possible perspectives of a phenomenon, which Carr admits (2008, 14).

Given these weaknesses, it is important to recognize that analogies are powerful in public discourse and affect our understanding of the development of the information technologies and related services. My position is that "flawed metaphors make faulty policy" and "flawed metaphors lead to faulty service offerings" (Johnson 2006).

In accordance with Lakoff and Johnson (2003), Abbate (1994) discusses how the cultural identity of new technologies is constructed through the use of metaphors, where the utility metaphor is one of several examined. The image of utility was meant to convey "reliable, unobtrusive, unvarying service" (Abbate 1994, 1), giving the metaphor a political role and gaining public support by focusing on the function at the cost of other aspects of the technology. Abbate (2001) does not draw on the neutrality of the metaphor, but rather on the use of metaphors as instruments of power.

My focus is on how utility indicates neutrality – for instance, in the ways in which information technologies are described as mere infrastructures of transportation that are indifferent to the content of the systems, and to its users (compare van Dijck 2013).

Collection of material

The article consists of a document study, where historical documents containing the utility metaphor – i.e., sources that compare the use of information technologies with utilities, such as electricity, water, etc. – were considered relevant. I do not claim that all existing documents are covered. The starting point for finding relevant documents was Carr's (2008, 59) reference to McCarthy (1962). Databases were searched for additional material, with a combination of terms: *utility, metaphors, electricity, computing, information technology.*

To find references on neutral metaphors of technology, van Dijck's (2013) book chapter on Twitter as neutral utility, and an article by Hirschheim and Newman (1991) discussing the tool metaphor, were useful. Searches on Google scholar, with the terms *technology as tool*, *neutral*, and *metaphor* resulted in additional relevant sources.

In addition, *Google scholar* was searched for sources referring to all of the references found. The *pearl growing* technique (Ramer 2005) was used on the relevant publications to find additional texts. Some material was not available in full text, or in print.[1] The material in the document study was analysed in relation to different technological inventions, following a time sequence identified by publishing year.

The utility metaphor explored

There are a substantial amount of sources on the development of computing and related internet technologies containing the utility metaphor. In this section I present the findings linked to five different time periods, the first dating back to the late 50s: *Time-sharing*, *Computer networks*, *The computer grid*, *Utility computing*, and *Cloud computing* (table 1). The time periods are generated from publication years, and should not be mistaken for the years the metaphor was in use.

Time period	**Utility metaphor**	**Technology**	**Business model** (first appearance)
1958–1967	Time-sharing	Packet-switching, super computers	Time-sharing
1972–1978	Computer networks	Computer networks infrastructure, super computers	Personal computer (PC), mini- and micro- computer
1997–2002	The computer grid	Virtualization, Internet, World Wide Web, personal computers	On-demand access, Software as a Service (SaaS), Outsourcing
2003–2006	Utility computing	Virtualization, Internet, World Wide Web, personal computers	User Service
2007–2011	Cloud computing	Mobile devices, location-based services, internet of things	Infrastructure as a Service (IaaS), Platform as a Service (PaaS)

Table 1. Overview of the different time periods, with related utility metaphor, technology and business model. The time period reflects the publishing years of the sources reviewed.

According to Carr (2008), McCarthy (1962) was the first person who visualised computing as a utility. However, the review suggests that Bauer (1958) was prior to McCarthy, at least in print.

Time-sharing as a utility (1958–1967)

Time-sharing is an early method to make super computers available for more than one task/user at a time. It also became a main driving force for networking, creating a sense of community among academics (Naughton 2000). Schwartz *et al.* define time-sharing as "the simultaneous access to a computer by a large number of independent (and/or related) users and programs. The system is also 'general purpose,' since there is essentially no restriction on the kind of program that it can accommodate" (1964, 397). As many others, Bauer (1958), chief executive officer of Informatics General Corporation, claimed advantages in making computation more effective and economical. His vision of *Ultradatic*, a super computer, is one of the first evidences of the analogy of computing and utility:

> *The central idea here is that each large metropolitan area would have one or more of these super computers. The computers would handle a number of problems concurrently. Organizations would have input-output equipment installed on their own premises and would buy time on the computer much the same way that the average household buys power and water from utility companies.* (Bauer 1958, 49)

Furthermore, he pointed out the importance of computers being accessible for different individual needs: "The changing needs of the user result from considering the computer as one part of a larger information handling system where man-machine communication is of great importance" (Bauer 1960, 41). A few years later, in a lecture held in 1961, McCarthy predicts:

> *If computers of the kind I have advocated become the computers of the future, then computation may someday be organized as a public utility, just as the telephone system is a public utility. We can envisage computing service companies whose subscribers are connected to them by telephone lines. Each subscriber needs to pay only for the capacity that he actually uses, but*

> *he has access to all programming languages characteristic of a very large system.* (McCarthy 1962, 236)

These quotes are eerily similar to the excerpt from *The Big Switch* that opened this article (Carr 2008). As we will see, it is possible to discern a pattern in which various strong utility metaphors are quickly modified in further discussions. For instance, Fano (1965), referring to McCarthy's lecture, modifies the utility metaphor by comparing computing as a logical power with the early source of mechanical power.

> *The analogy between electric power and computer power illustrates only one of the aspects of a computer utility – namely, its ability to provide the equivalent of a private computer whose capacity is adjustable to individual needs. Of much greater importance to the individual customer would be the benefits that such a utility could make available to him by placing at his fingertips a great variety of services in the form of public procedures, data, and programming aids, and by allowing him to store and retrieve his own private files of data and programs. Furthermore, a computer utility could provide customers having common interests with convenient means for collaboration. For instance, designers working together on a complex system could check continually the status of the overall design as each of them develops and modifies his own contribution.* (Fano 1965, 56f)

The time-sharing discussion was aimed at extending the range of a centralised system, already in place. Further on in the article, we will see that cloud computing discussions are, on the contrary, aimed at centralising a decentralised system.

As the utility metaphor increasingly becomes accepted, there is growing awareness that computing is different than electricity. Greenberger, in scrutinizing the analogy, finds such differences. Concerned with differences, he notes that a computer "has a kind of universality and generality not unlike that afforded by electric power" (1964, 63f). It seems that electricity "is immediately available" (ibid., 64) and in order "to get electricity, we simply reach over and flip on a switch or insert a plug into an outlet. Computers, by contrast, seem complex, forbidding, and at a distance from most potential users, both in space and time" (ibid.). Further, "electricity is a relatively homogeneous product" while computation "is dynamic in form, and its course is typically guided by action of the user" (ibid.). Greenberger suggests "an on-line interactive computer service, provided commercially by an information utility, may be as commonplace by 2000 A.D. as telephone service is today" (ibid., 63). In his article he makes predictions of possible future uses of the information utility. As we will see, similar visions reoccur in the following time periods.

At this point there are several different computer utility concepts in use: *information utility*, *information network*, *time-sharing*, and *fireside computer* (Parkhill 1966). Both Parkhill (1966) and Barnett and Anderson (1967) elaborate on the suitability of the term *utility*. Parkhill views computer utilities as much more complex and numerous than the traditional utilities, referring to connotations such as electrical power or the telephone, which "merely denotes a service that is shared among many users, with each user bearing only a small fraction of the total cost of providing that service" (1966, 3). Barnett and Anderson point to two problems using the utility concept. *Firstly*, it "implies some degree of regulation. This implication of regulation flows from the fact that all public utilities are regulated" (1967, 15). *Secondly*, the utility concept seems to suggest a particular entity, but instead it appears to "indicate that 'computer utility' is more of a generic term which describes a whole spectrum of computer-oriented facilities which offer various services appropriate to a variety of dissimilar user requirements" (1967, 16).

Although the personal computer (PC) was in common use decades later, something similar was envisioned through the utility metaphor. In his emphasis on possibilities of "intimate" user/computer collaboration, Fano's (1965) ideas hook on to the earlier visions of man–machine communication (Bauer 1960), "a man-computer symbiosis" (Licklider 1960), of a two-way dialogue between the user and the computer. This approach seems to affect developments in the new technology. Fano and Corbató claimed that time-sharing during recent years had "created an unexpected new order of uses for the computer" (1966, 129) uniting people and utilizing common knowledge. They saw that time-sharing could facilitate "an intellectual public utility" (ibid.).

There are contemporary visions where Fano and Corbató (1966), Parkhill (1966) and Irwin (1967) elaborate on the future of this new technology. Fano and Corbató discuss additional requirements and improvements for time-sharing to become a utility: "A public utility must be available to the community 24 hours a day and seven days a week without interruption" (1966, 134). Here is a passage where a social shaping approach can be discerned, with foreseeable good and negative consequences of the new technology for society:

> *Looking into the future, we can foresee that computer utilities are likely to play an increasingly large part in human affairs. Communities will design systems to perform various functions – intellectual, economic and social – and the systems in turn undoubtedly will have profound effects in shaping the patterns of human life.* (Fano & Corbató 1966, 140)

Further on in the text it becomes obvious that it is strongly influenced by cybernetics (Wiener 1948), a system theory approach that argued neutrality regarding human and nonhuman resources that was quickly gaining prominence within many disciplines at the time:

> *The coupling between such a utility and the community it serves is so strong that the community is actually a part of the system itself. Together the computer systems and the human users will create new services, new institutions, a new environment and new problems. It is already apparent that, because such a system binds the members of a community more closely together, many of the problems will be ethical ones. The current problem of wiretapping suggests the seriousness with which one must consider the security of a system that may hold in its mass memory detailed information*

> *on individuals and organizations. How will access to the utility be controlled? Who will regulate its use? To what ends will the system be devoted, and what safeguards can be designed to prevent its misuse? It is easy to see that the progress of this new technology will raise many social questions as well as technical ones.* (Fano & Corbató 1966, 140)

Similarly, Parkhill (1966, 153-171) predicts the coming transformation of different aspects of everyday life due to the utility of computers, for example, in the monetary system, computerized shopping, information services (medical-information utility, electronic library utility of lawyers and other occupational groups, library systems, encyclopaedias), interactive processing (design, problem-solving, engineering, programming, military planning, game playing, and education), automatic publishing, economic planning and control, as well as social implications (industrial espionage, surveillance, political control, censorship, unemployment *et cetera*). Realizing this text was written almost fifty years ago, it is remarkable the extent to which these predictions have come to be aligned with recent developments.

Irwin's (1967) vision of computer utility as an informational grid is similar to Parkhill's: "These systems will cover the U.S., establishing an informational grid to permit the mass storage, processing and consumption of a variety of data services: computer-aided instruction, medical information, marketing research, stock quotations, airline and hotel reservations, banking by phone – to mention only a few" (Irwin 1967, 1299). By and large, Parkhill's, Irwin's and others' visions are sophisticated descriptions of our contemporary information infrastructure.

Time-sharing as utility clearly allows visionary discussions on the transformation of society, free from political and ideological frames. Increasingly, discussions during this time-period take on the character of social engineering, transforming the way that society functions. There is also a clear countermovement in the literature, as there are critics to the simplifying character of the analogy with electricity.

Computer networks as a utility (1972–1978)

If the main part of the literature from the 50s and 60s was written by people with knowledge of the evolving technology – since they often were a part of this development – the literature from the following period was mostly written from organisational, institutional, economical and societal perspectives. It is also possible to distinguish progress from the individual organisation's perspective, moving on to societal and global perspectives. *Computer utility* and *computer network utility* are used synonymously in the texts studied during this time period.

Feeney (1972), at the time employed at General Electric, holds a positive view of centralisation from a corporate perspective and refers to the developments of electrical utilities – from many local to a few central power facilities – as generating economies of scale. He is optimistic when stating that "computer utilities will provide a superior alternative to the fragmentation and inefficiency of today's decentralized computing even as electrical utilities replaced established decentralized power generation seventy years ago" (Feeney 1972, 237).

References to fragmentation concern the situation of super computers becoming less exclusive than earlier. The widespread use of the PC is still in the future but many corporations and institutions now host their own micro or super computer. Feeney claims that computer utilities "portend some fundamental changes" and are both affected by and affect "the way computing is sold, produced, and used throughout the world" (1972, 237). We here find promotion of the utility metaphor very similar to descriptions of cloud computing in recent years:

> *[T]he glamour surrounding computers themselves has started to fade. Many companies are looking for relief from . . . [the] unending cycle of system upgrade, over-capacity, under-capacity, and then yet another system upgrade. Even larger firms, which could afford to provide their own centralized computer networks, are questioning why they must operate their own systems to enjoy the benefits of efficient computing, any more*

> *than they must operate their own generators to obtain the full benefits from electricity. The computer utilities offer a services alternative that makes computing a discretionary cost rather than a fixed burden.* (Feeney 1972, 237)

Many saw computer networks as something that could counter fragmentation. Bell (1974) discusses the usability of computer networks in economical and efficiency terms. He also compares the development of computer networks with the development of other utilities, such as communications, power, and transportation. His emphasis is on the community level, providing broadly available services, "for whole 'communities,' such as businesses, homes, and government departments, which would provide services such as credit card transactions, printed message delivery, news distribution, and library information retrieval" (Bell 1974, 44).

Similar to Bell (1974), Kahn *et al.* (1978) also supply examples of future computing networks for individual information needs, enabling access for nearly everybody "to an all electronic computer-based network . . . to become commonplace throughout the fabric of our society: in the home, in mobile environments, and so forth" (Kahn *et al.* 1978, 1303). They also claim that "[m]ost of the world's information will one day be in digital form stored in a computer system or knowledge base. Access to this data will be essential (as will protection against unauthorized access); telecommunications is the only viable means of providing it" (ibid.).

Licklider and Vezza (1978) called for "world leadership", referring to the lack of interest and leadership from the decision-makers of national policy issues to enable a coherent network, which they saw as a necessity for use on a general level. They state that "[i]n an information network, coherence is desirable partly for the same reason it is desirable in a telephone system" (Licklider & Vezza 1978, 1342). The decision-makers seem "not to be aware that any significant new potential exists or that there may be any reason to move rapidly to take advantage of it" (Licklider & Vezza 1978, 1344).

While the utility metaphor seemed to be a promising instrument for connecting with policymakers, it was simultaneously critically modified in discussions. Massy (1974) fears the consequences of computer utility – i.e., large-scale computing machines, capable of serving a great number of users – within the academic institutions, would bring centralisation. He is critical to the use of the word utility, arguing that it can be misleading. Compared to electricity, which is homogenous, yet "applied to user needs through a variety of types of equipment," computing "is many commodities in one" (Massy 1974, 416). He discusses problems relating to the implementation of centralised computing systems. Massy claims that political interests may work against implementation, in efforts to maintain local control. He states that "different users have different needs, just as different people have different preferences for goods and services" (Massy 1974, 417). Centralisation would need standardisation, among other things, at the expense of these individual's needs. He also claims that "[w]hatever economies of scale may be achieved [may decrease with] the inefficiencies of managing such a large and complex organization" (ibid.). Instead, Massy (1974) argues for a distributive network, where the user would be able to choose from a variety of sources and services. He views the distributive network as a way of combining computing and maintaining control, serving special needs, and avoiding standardisation.

Interesting for the further discussion is the way that the utility metaphor is extended through the connection with centralisation and standardisation. These are notions that emphasize similarities with electricity/water distribution; that the flow of information is akin to that of water on tap.

The computer grid as a utility (1997–2002)

With the popular breakthrough of the internet and the World Wide Web in the early 90s, the trajectory of the computer network was completed. People were connected endpoint to endpoint in a distributed network, instead of separated networks as before. With its open and decentralised architecture, the internet quickly drove centralised proprietary competitors out of business (Zittrain 2008). After years of relative silence in the 80s and early 90s – except for research within Information systems in the use of the utility metaphor (Lacity and Hirschheim 1993) – it re-emerged in the late 90s.

The utility metaphor now shifts from the comparison of *computing* with power as such, to the *distribution* of power – the power grid. Accordingly, Foster and Kesselman (1999) state that in the beginning of the last century the "truly revolutionary development was not, in fact, electricity, but the electric power grid and the associated transmission and distribution technologies. Together, these developments provided reliable, low-cost access to a standardised service, with the result that power . . . became universally accessible" (Foster & Kesselman 1999, 17). They define computational grid as "a hardware and software infrastructure that provides dependable, consistent, pervasive, and inexpensive access to high-end computational capabilities" (Foster & Kesselman 1999, 18). However, they see analogies as "dangerous things, and electricity is certainly very different from computation in many respects" (Foster & Kesselman 1999, 20).

Crucially, this new discussion tends to collapse the earlier distinction and comparison with electricity. The utility is now reconceptualised to include computing. Another major aspect of the grid utility discussion is to renegotiate the role of the decentralised/distributed internet. From this perspective, it can be argued that the internet is an immature technology that will evolve into a utility with time. For instance, Birnbaum (1997), senior vice president for research at Hewlett-Packard, suggests that the internet is facilitating an "important change" as "the first stage of a digital infrastructure that will eventually bring global information and computing to most homes, schools, businesses, and other institutions. . . . Just as people pick up a phone expecting a dial tone, people will expect the information utility to be available, ready, and waiting" (Birnbaum 1997, 41).

Birnbaum (1997) is also concerned with the economic model of the utility. He points out that people connecting to the utility only pay for their own usage, which would represent "an enormous paradigm shift, changing what is now a capital investment into a competitive service, like electricity and water" (1997, 41). Both Foster and Kesselman (1999) and Birnbaum (1997) are here referring to the individual's readiness to pay according to use.

Gentzsch (2000) recognises not only the possibilities of resource sharing, but also envisages another step towards the realisation of the utility analogy of computational grids. He argues for the possibility of creating computational grids by developing software, making it possible for anyone to "sell idle CPU cycles, or those in need can buy compute power much like electricity today" (Gentzsch 2000, 2). Gentzsch foresees the future of the grid – comparing it with electric power consumption, telephony, water supply and roads infrastructures – capable of "match[ing] the user's compute jobs with the available resources in the network" and when fully developed incorporating "intelligent mobile agents, which enable a universal and self-healing environment with potentially infinite compute power available on-demand" (2000, 3).

Chetty and Buyya (2002) identify several similarities in the analogy of computational and electrical grids in technical parameters and quantities on the structure and the operating model. They conclude that "an operational model (a regulated system or otherwise), proper division of the computational grid into regional pools, coordinated system operation to ensure network stability, and ease of use must all be priorities in further grid development" (2002, 70).

As we can see from these sources there is continuation in the efforts to portray computation as a utility. In a sense, much more emphasis is placed on information flow as electricity. At the same time, there is increasing emphasis on aspects of water as utility, as the user can adjust the faucet to the preferred flow. In both regards, the metaphor suggests that this flow is a neutral resource. The emerging development and use of the internet, would push this effort one step further.

Utility computing (2003–2006)

The term *utility computing* first appears in the late 90s and the concept attracts more attention during the 00s. IBM defines utility computing as "the on demand delivery of infrastructure, applications, and business processes in a security-rich, shared, scalable, and standards-based computer environment over the Internet for a fee. Customers will tap into IT resources – and pay for them – as easily as they now get their electricity or water" (in Rappa 2004, 39). Other researchers, such as Yeo *et al.*, define utility computing as "[a] model whereby service providers offer computing resources to users only when the users need them and charges the users based on usage" (2006, 21). "Its analogy is derived from the real world where service providers maintain and supply utility services, such as electrical power, gas, and water to consumers" (ibid., 1).

The analogy to electricity is also used by Siegele (2003): "In the early days of electricity . . . most firms had to have their own generators." (2003, 2) Computing is a utility since the user can utilize computing resources, such as software, according to needs and is able to share resources with others. He states that software is sold as a "manufactured good" though it is a "service at heart" (ibid.), but to become a true utility it has to be developed and possible to deploy as web services (ibid., 3).

Similarly, Rappa (2004) argues that developments have generated high expectations and reliance on computer services. He continues: "This expectation is not unlike that seen in other areas of technology to which modern society has grown accustomed; for example, the dependence on a ready availability of affordably priced electricity. . . . [W]e have seen electricity grow beyond a modern everyday convenience to become a necessity in the lives of most people" (Rappa 2004, 32). Rappa views computing as a utility, in the form of shared computing resources through a computing grid, since PCs, together with the internet, have created activities that are "mainstream." He continues, "Computer and network services are an end-to-end component of many businesses processes. To be without service is not merely an inconvenience; it is a potential financial disaster" (2004, 40).

With the coming of on-demand computing and virtualized data centers, Wladawsky-Berger (2004) identifies the same pattern of development as Carr (2005): "It is only a matter of time before information technology achieves the kind of productive anonymity that electricity did when standards made it ubiquitous and routine (if occasionally troublesome)" (Wladawsky-Berger 2004, 33f). He claims that the grid will encompass different services, such as "systems, business processes, organizations, people," that will be "thoroughly integrated" like "a smoothly functioning whole . . . in close dynamic communication." Wladawsky-Berger also states that the grid will facilitate "resources fully employed" and improve service quality "as the infrastructure becomes more self-configuring, self-optmizing [sic!], self-healing, and self-protecting." He also views the computer grid as a means of increasing flexibility in "choices based on business needs rather than architectural 'issues'" (2004, 28). During this period the analogy is further elaborated. Through the emphasis on the computer grid as self-sufficing, the utility metaphor is pushed to its limits. It is difficult to reconcile these notions with the straightforward flow of water on tap. Utility computing is portrayed as multifaceted, flexible, security-rich and scalable.

Concluding discussion – Cloud computing as a utility

The utility metaphor has been employed to explain the development and changing nature of computing technologies since the late 50s and onwards. In this article attention is paid to some hidden aspects of the use of the utility metaphor. Different, sometimes iterant, reasons for and against the use of the utility metaphor have been debated.

The starting point of this article was the frequent usage of the utility metaphor in connection with cloud computing. For instance, Weiss discusses cloud computing "inspired by a computing model from the past" of mainframes and super computers where "[p]rocessing time was delivered like electricity" (2007, 21). Barnatt states that cloud computing "will transform computing into an on-demand utility much like water or electricity" (2010, xi). Buyya (2009) and Buyya *et al.* (2009, 599f) share this view, conceiving cloud computing as the fifth utility following water, electricity, gas, and telephony. They emphasize the shift of computing to "services that are commoditised" (Buyya 2009, abstract). Kushida *et al.* (2011) instead emphasize that it is a *dynamic* utility, which in several ways differs from electricity. They refer to economics as the driving force, similar to Carr, who specifies economic factors such as change of work and way of living: "Computing is turning into a utility, and once again the economic equations that determine the way we work and live are being rewritten" (2008, 12). According to Carr (2008), cloud computing signifies utility achieved.

Again, these statements can be recognized as echoes from earlier time periods, with their emphasis on functionality and economy. The arguments in these texts are normative, as are the accounts from the historical material previously discussed, subsequently lacking analytical discussions on societal and political consequences. The documents focus business models, efficient use of resources and business opportunities. The metaphor is loaded with positive connotations purposely intended to show that technology is a self-evident part of our daily environment.

As discussed, metaphors play different roles, such as *sense-making, constitutive, restrictive* or *tools of power*. The utility metaphor, in the development of computers and related internet technologies, can be understood to have all these different roles, but with different emphases in different time periods.

Initially, in the late 50s and during the 60s, the metaphor's main role was to *make sense* of the new technology, among IT professionals, economists, and the public, thus revealing its potential. There was a need to make sense of the new phenomena by using an old concept; here the utility concept was adopted (among others).

From the 70s and onward, the role of the utility metaphor was also mainly *constitutive*. The metaphor constitutes a new way of perceiving computing as a service instead of a product. Furthermore, the fact that a utility is *functional* and *standardised* constitute an understanding that it is easy to use, since utilities are well known and intimately included in our sensory experience. Most of us know how comfortable it is to switch on or off an electronic device, for instance – but on the other hand, the metaphor also creates expectations of the provision in terms of the users' different needs, since a utility can be expected to be well adapted for its purpose.

Overall, the metaphor generated positive connotations and did not function as *restrictive* to any great extent (although metaphors always function restrictively in some sense). There have been critical contemporary voices on the suitability of the metaphor, but the critique has remained at the level of comparing computing and electricity, not scrutinizing the underlying assumptions of the utility concept as such. Early on, in the late 60s, there were some fears expressed about the kind of society created through the construction of this utility: "It is easy to see that the progress of this new technology will raise many social questions as well as technical ones" (Fano and Corbató 1966, 140).

During more recent time periods, this lack of scrutiny of the utility metaphor – taking it for granted – reveals a normative approach. In the reviewed material, there is much attention on useful business models, where the efficient use of resources at lower costs and enhancing business opportunities. Here, the use of the utility metaphor is unquestioned as *a tool of power*.

Important *narrative themes* in the texts are the polarizations between:

- Centralisation/decentralisation,
- Flexibility/control,
- Commercial/non-commercial, and
- Standardisation/specialisation.

The constant tension between the narrative themes of *centralisation* versus *decentralisation* is often tied to business models negatively affected by the development of the PC and the internet. Debates post PC/internet tend to argue that the technology is immature or problematic but that society nevertheless is in need of a strong utility model. This makes the model increasingly connected to tools of power in recent decades. Following this, Abbate (2001) has argued that before the internet, the technological development of computer network design decisions were formed by organisational frameworks. Use of computers should be "simple, centralized, and relatively user friendly, but with access strictly controlled and usage metered" (Abbate 2001, 156f). A centralised service allows control, which was important also for economic reasons.

The narrative of *flexibility* versus *control* is central in the understanding of the technological developments. Control was exercised as "[c]ommercial systems limited what users could do and did not invite or allow them to add to the network's capabilities" (Abbate 2001, 157). In line with Abbate's argument, Zittrain (2008) asserts that "tethered" technology will ensure that the control is kept, and that the power of development will stay by the developer. The narrative *commercial* versus *non-commercial* hooks on to these interests of delimiting what users can do on their own to satisfy special needs. Thus commercial interests are devoted to control, keeping and extending business.

Flexibility/control is also closely connected to *standardisation* versus *specialisation*. Since utilities are always standardised, differing individual needs are by default neglected. Initially a definition of the concept *utility* was formulated. The fact that a utility should be *standardised* and *well* *adapted to its purpose*, questions the utility metaphor as a suitable metaphor for computer services. The purposes for computing services can be diverse – not singular – and therefore also should be possible to adapt for special unique needs. Therefore, there is a contradiction in applying the utility metaphor to computer services, in line with others mentioned above. Applying the metaphor tends to neglect special needs and support developments that lead to more acceptance of standardisation at the expense of special needs. An expected consequence is that organisations have to adapt to the IT systems and change their processes.

As argued by Lakoff and Johnson (2003, 157), *how* something is pictured affects our conceptual frameworks in the constitution of social realities. Metaphors are useful in concretising diffuse phenomena, helping us to make sense of the unfamiliar. This study shows that the utility metaphor reappears over time although employed in different ways. From the late 50s and onwards there were visions of how computing could be developed in a utilitarian manner serving individuals, organisations and society. These visions of future computation as a utility, creating different useful services, have indeed become reality today, in the arrangement of internet and its related technologies. Consequently one can speculate, in accordance with Lakoff and Johnson (2003), that the metaphor in this case has been involved in the co-construction of social reality. Metaphors are powerful. Despite this statement, people can still choose how to adapt and use technology. By applying another metaphor, the "seamless web", it can be assumed that the development of technology is closely related to society, thus drawing on Bijker *et al.* (1987), viewing all knowledge as constructed; we can also affect how technology is constructed, adopted and used.

Maria Lindh, Ph.D. student at the Swedish School of Library and Information Science, University of Borås, Sweden. Her general interest is information management and the current focus is on the complexity and social shaping of information technology within the organisational setting. The Ph.D. thesis deals with the co-construction of cloud computing and related technologies.

Contact: maria.lindh@hb.se

Notes

1. Special thanks to Janet Abbate, who sent her unpublished article with sources from the 70s: Bell (1974) and Massy (1974) – referred to in footnote 9 in Abbate (1999).

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