Universiteit Utrecht

Indispensable Technologies

Mapping the co-evolution of needs and novelty in the digital revolution

For the MSc programme
Science & Innovation Management
Supervised by
Prof. Dr. Ir. Harro van Lente
Second reader
Dr. Ir. Alexander Peine

Bart A. Gzik (3235998)
April 2011

Contact information:
Email: bartgzik@hotmail.com
Postal address: Zeemansstraat 127, 1506EZ Zaandam
Tel.: 06 44 46 87 91

Title and Subtitle: **Indispensable Technologies: Mapping the co-evolution of needs and novelty in the digital revolution**

Author: Bart A. Gzik

Date: April 2011

Word count: Approximately 40.000

Abstract:

This study aims to investigate the co-evolution of technology and needs. It takes a look at, firstly, how some technology becomes indispensable; and secondly, when this occurs. In order to accomplish this, the study builds a framework from the concepts of the diffusion of innovations, social construction of technology and the sociology of expectations; the framework is linked to various indicators which are then analysed both quantitatively and qualitatively. Finally, the cases are subject to a further qualitative comparison. The study reveals that, amongst other things, indispensability in general appears to be a complex interaction between meanings in social groups, the value respectively attributed to these as well as the degree to which the artefact is routinised.

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1. Introduction

Googling the phrase: "necessity is the mother of invention", will yield many 'hits'. This age old wisdom holds true in an environment that is dominated by limited resources and the urge to fulfil unsatisfied needs; in such cases, human ingenuity comes out on top (Van Lente, 2009). But, maybe invention or innovation can create necessity or needs, too. Twenty years ago people did not have the need for Google and obviously, Google did not even exist yet and it was equally unthinkable that it would become a recognised verb ([1]). Most people in fact, did not even know what the internet was, and the personal computer was equally uninteresting or maybe even mystifying, for the average person. Fast forward twenty years later, and we see an entirely different world. The internet, computers and mobile phones are indispensable in our current world; they keep our economy running, we may need them to do our jobs, to keep ourselves up-to-date, and maybe more importantly, to be connected to society; we have to come to *need* technology or rather, it has become *indispensable* to us. How did this occur?

In this study I will explore the process by which some technologies become indispensable. Something is indispensable when it is absolutely necessary or absolutely essential ([1]); thus indispensability is closely related to needs. Note that, instead of needs being merely latent states that await satisfaction by innovation or marketing, innovation can create a state of indispensability or "needs", too. For instance, a machine *needs* certain parts for it in order to perform its tasks; these parts are very well essential for its "survival". In the case of computers, computer software is indispensable to computer hardware (Rogers, 2003). In similar spirit, technology that we use today may have become essential, maybe not for our survival, but certainly for our current modi operandi and routines. Indeed, indispensability of technology is something that is visible in society today; here technology has created needs of its own. Information and communications technology has become so intertwined with our daily lives that it is no longer a luxury but something that we *need* in order to function, or feel connected to society; the examples are all around us (Chareongwongsak, 2002; Institute for International Policy Studies, 2003[2]; Perelman, 2008; The Bottom Line, 2008[3]; Tech Liberty NZ, 2010[4]; BBC, 2010[5]; Volkskrant, 2010[6]). How does such indispensability emerge through time? When does this indispensability occur and in what way does an innovation reach a state of indispensability?

The aim of this research is to contribute to existing literature in innovation studies by investigating the co-evolution of needs and novelty. In this study, three cases from the digital revolution will be studied: the internet, mobile phones and personal computers; thus, the study is limited to ICT technology. In addition, the study will limit itself to the Netherlands from 1990 until 2009. These boundaries will allow me to conduct this research within the boundaries of time, resources and effort.

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[1] Oxford dictionaries, 2010, respectively queried: Google, needs, indispensability: *http://oxforddictionaries.com*

[2] IIPS, 2003, The Spread of Information Technology and Change in Society: *http://www.iips.org/Viewpoint_Hiroki.pdf*

[3] The Bottom Line, 2008, Cell Phone Dependency Causes Disconnection: *http://thebottomline.as.ucsb.edu/2008/05/cell-phone-dependency-causes-disconnection-by-nicole-richards*

[4] Tech Liberty NZ, 2010, Internet Disconnection is Not an Option: *http://techliberty.org.nz/internet-disconnection-is-not-an-option/*

[5] BBC, 8 March 2010, Internet access is a 'fundamental right': *http://news.bbc.co.uk/2/hi/technology/8548190.stm*

[6] Volkskrant, 16 April 2010, D66 congres: Internettoegang is grondrecht: : *http://www.volkskrant.nl/multimedia/article1370442.ece/D66-congres_internettoegang_is_grondrecht*

I propose the following research question:

RQ: “How and when have ICT artefacts transformed from ‘novelty’ to ‘indispensable technology’ in the Netherlands from 1990-2009?”

In the remainder I will elaborate how to investigate this question. Section 2 covers the theoretical basis from which I have devised the conceptual framework. The methodology used in order to answer the aforementioned research question is discussed in detail in Section 3 of this proposal.

2. Theoretical Framework

What, in the first place, are needs then? “Needs” is a loaded concept, and there are many different conceptualisations throughout various fields. In its most basic form, Maslow (1954; in: Lester, 1990) classifies a variety of human needs, namely: physiological, safety, belonging, esteem and self-actualisation, and places these in a hierarchical structure; thereby arguing that some needs may be more important than others (Lester, 1990). Philip Kotler et al. (1999, p. 10), a famous scholar in marketing, describes needs as a “state of felt deprivation”; in other words, we perceive a need for something because we cannot do something that we want to do. Scholars of marketing often argue that needs already exist before the introduction of a new product or service. They are merely latent and marketing strives to satisfy these hidden needs (Kotler et al. 1999). In similar spirit, Rivers (2008) argues that technology does not create need; instead, he argues that technology merely satisfies needs that have been created by societal conditions and that what we have are “technological needs” or “technological wants”, but none of which are essential to our survival.

In the meanwhile, innovation research approaches needs in: firstly, the line of research of (lead) user involvement during innovation. Here, again, the primary goal is to satisfy existing user needs; thus we talk about the inclusion of user needs in order to improve an innovation (for example: Lundvall 1985; Von Hippel, 1986) or the inclusion of users so as to re-invent innovation, satisfying their specific needs and thus allow it to be adopted quicker across a segment of society (Rogers, 2003). Secondly, Abernathy and Clark (1984, p. 6-7) suggest that innovations articulate latent needs: “An innovation …creates new markets, supports freshly articulated user needs in the new functions it offers”; this is naturally similar to the line of reasoning in marketing. Howells (1997) argues certain “needs” may exist because technology has created a new pattern of use or societal circumstances; in this sense, our needs could have been “artificially” created where none may have existed before; finally, work by Graber (2007) shows the creation of needs by innovation in the past. Here, Graber describes how previously non-existing needs for a more efficient water supply system are “invented” by engineers, which arguably reshaped Parisian society as water supplies became abundant; Graber of course did not argue about the need of fresh water itself as this is a basic need for life, but rather how much water an average person or household would use.

The gradual spread of technology is also studied by Rogers (2003) and his work on the diffusion of innovations. According to Rogers, diffusion is the way with which “innovation is communicated through certain channels over time” (Rogers, 2003 p. 11). Rogers writes that the rate of adoption is influenced by relative advantage, compatibility (with social values or existing routines), complexity, trialability and visibility. Some helpful concepts - in context of indispensability - that Rogers mentions in his book are the so-called critical mass and routinisation. As the process of diffusion continues, the innovation may reach a “critical mass”; this critical mass is the point at which the rate of adoption for the innovation becomes self-sustainable because enough individuals of a specific system have adopted it (Rogers, 2003). Rogers argues that this critical mass is especially distinctive with so-called interactive technologies such as e-mail, telephones (but not cell phones because they make use of the existing infrastructure for telecommunications), fax et cetera, because it creates interdependence of adopters in a specific system. The second concept is “routinising”; this occurs when an innovation has lost its separate identity and is being incorporated into the regular activities of an entity.

In the context of market maturity and dynamics, we may see a transition from an unarticulated complex market towards a more differentiated one. The initial state of the market is then characterised by unknown use for the innovation and consequently unknown users, this may transition to a state where user needs are known and competition is rather based on quality and features as the market matures (Tidd, Bessant & Pavitt, 2005). As the market matures it is characterised by transition towards gradually lower technological uncertainty, increase of product performance, extension of services and lower manufacturing costs (Brem & Voigt, 2009). Therefore, It can take time for certain complex artefacts (such as the internet) to acquire meaning and become socially embedded.

Here, the social construction of technology (SCOT) plays a role because it assumes that technology is an open process; a different social context in which the artefact is developed and evolves, may yield different outcomes of use. The evolution of technology is furthermore a social endeavour because each and every unique social group involved may have a different interpretation of the same artefact (Klein & Kleinman, 2002); or as Pinch and Bijker write: "all members of a certain social group share the same set of meanings, attached to a specific artefact" (Pinch & Bijker, 1987 in: Klein & Kleinman, 2002, p. 30). Thus, each social group is a separate agent that imparts meaning upon the artefact (Klein & Kleinman, 2002). Another important component of SCOT is "closure and stabilisation"; this takes place when a specific social group accepts that the artefact works for them, it is either that no more problems exist in the multi-group process or that the problem is redefined so that they are no longer problems as such (Klein & Kleinman). What SCOT tells us then is that technology, meaning and use evolve as the innovation is communicated throughout a specific social context and that meanings and use differ per social context. Thus, this communication holds performative power; this seems to be related to another helpful concept in understanding the communication of technology via social channels, namely: expectations.

Nathan Rosenberg writes that: "expectations concerning the future course of technological innovation are a significant and neglected component …inasmuch as they are an important determinant of entrepreneurial decisions with respect to the adoption of innovations" (Rosenberg, 1976: p.523). This implies that expectations possess a performative power to shape things around them, especially concerning new technologies, where many different parties such as scientists, policy makers, firms, et cetera, observe the new technological field with great interest (Van Merkerk & Robinson, 2006). Guice (1999) even goes so far as to stress the importance for the technical communication to contain a "prophetical" element; because, we need expectations to create basic activities, such as the mobilisation of actors and recourses so that the technology transforms from rhetoric to social reality (Van Lente & Rip, 1998; Guice, 1999).

Based on the aforementioned theory, I will now explain how several selected concepts relate to indispensability and how they can assist in creating an understanding of "when" and "how" a technological artefact becomes indispensable.

Rogers (2003), in his book "Diffusion of Innovations", writes that the final step in the innovation process is "routinising"; as mentioned before, this occurs when an innovation has lost its separate identity and is being incorporated into the regular activities of an entity (Rogers, 2003). Similarly,

Burkhardt and Brass, in their 1990 paper, investigate the implementation of a computer network in a firm, and argue that, as the system became more imbedded into the employees' routines, old routines were replaced and a shift in the firm's culture took place; similar shifts in societal culture may be observed. A **routine** is an easy to understand concept and is little more than a "recurrent interaction of patterns" (Nelson & Winter, 1984 in: Hoeve & Nieuwenhuis, 2006) but is of importance for this research because it is closely related to societal embedding. Societal embedding can be seen as a process of "embedding in existing practices and cultural repertoires of users" (Geels, Pieters & Snelders, 2007). As the technology is embedded into society it becomes familiar and may become part of an everyday tasks inducing a sense of mundanity; these rituals provide security and predictability and the lack of these will be seen as a disruptive event (Hoffman, Novak & Venkatesh, 2004). Following this reasoning, I argue that societal embedding in the form of routines is an important factor in establishing whether a technology - in context of its use - may be perceived as indispensable or not. Therefore, amongst other things, the research will focus on following the emergence and evolution of routines through time as they are one of the elements that can describe the "how".

Naturally, in order for technology, such as the mobile phone, to become indispensable it needs to be diffused throughout society first; this may create a so-called reciprocal interdependence where it becomes increasingly beneficial for users to adopt the innovation as the number of adopters itself grows (Rogers, 2003). During the early stages of diffusion however, adoption of the innovation is very low; the relative advantage may not be recognised by future users; there may be compatibility problems with current social values; the innovation, because of its new character, may be experienced as complex; trialability is low because the innovation is not available in large quantities and therefore this affects visibility as well (Rogers, 2003). In terms of supply and demand, we see a generally unarticulated complex market which gradually may or may not shift towards an articulated and differentiated one. The initial state is characterised by low product availability, high costs, low visibility in mass media as well as a largely undefined user-base - where statistical analysis of existing customers is of no use - and undefined uses; thus unarticulated supply and demand. The latter state is characterised high product availability, low(er) costs, familiarity, a more defined user-base - that can be targeted for marketing – and defined uses; thus articulated supply and demand (Tidd, Bessant & Pavitt, 2005; Brem & Voigt, 2009). Tracking this increase consequently provides an answer to "when", as a function of time, an innovation may become indispensable. If the technology is not rejected along the way, it will become **"adopted"** by society; and over time, the technology, or rather the access or supply, becomes more "**available**" in order to meet ever increasing demands. Together, these concepts provide a valuable context for determining the "when".

On their own, the respective evolution of routines, adoption and availability has little depth. They are arguably derivatives of the societal and technological side of innovations, but require a channel of communication. In terms of marketing literature and pure market dynamics this channel of communication is often seen as the "market"; for this paper, I would like to propose "expectations" instead because these function as a channel of communication between technology and society (Borup et al., 2006). Naturally, expectations or discourses possess their own quality of attention; I will refer to this as the amount of "**visibility**" that a technology possesses (Van Lente & Spitters, 2009). As mentioned before, expectations are important because they generate an interest in specific technologies, and can mobilise resources and actors for the pursued technology. Expectations often

contain a future element (Ruef & Markard, 2010) and because of their performative power, they may determine whether a technology is worth pursuing in the first place; they may provide meaning to potential rise and fall in adoption and availability; importantly, they may provide insight in the future meanings and uses that will be imparted upon technologies; and finally, they may provide insight in the evolution of routines and the uses that future users may perceive. In other words, they provide a background for all the aforementioned elements and are therefore valuable for both the "how" and "when".

In summary, I hypothesise that novelty has the power to create needs where none existed before; thus novelty modifies existing society and life. During this co-evolution of needs and novelty we can identify a process from high uncertainty, low availability, adoption and little visibility towards a more stable and certain environment with less technological risk, higher availability of the innovation, higher rate of adoption and higher visibility. In other words, we should see a shift from unarticulated supply and demand towards articulated supply and demand.

Expectations or discourses have consequences because they may influence the technological development (both in speed and direction) and societal embedding (again, arguably in both speed and direction). Naturally, this works the other way around as well; both technology and society may start new discourses. Considering all the above I propose following framework for the co-evolution of needs and novelty (see Figure 1).

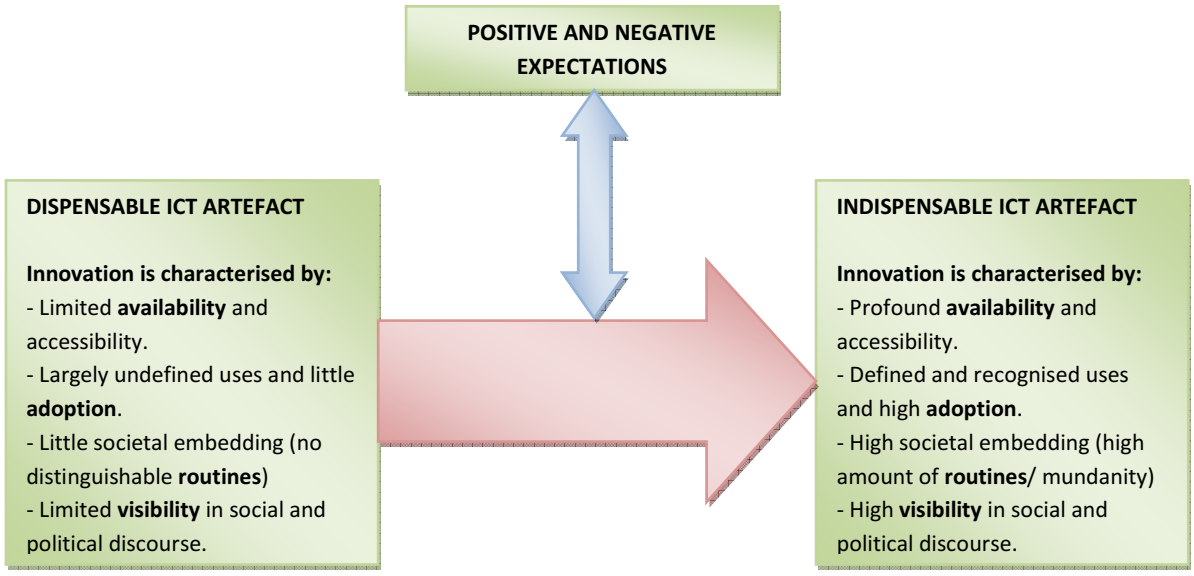

Figure 1: A framework towards the indispensability of ICT artefacts.

3. Method

Cases for this research were selected on the basis of being indispensable in our modern society today. The three cases to be studied are all ICT related and include the mobile phone, personal computer and the internet. These cases will be studied over a period from 1990 to 2009; in light of 20 years of digital revolution in the Netherlands. The timeframe as well as the recent developments in ICT technology will allow for a high level of traceability and homogeneity throughout the research. The technologies have been chosen in terms of traceability first and foremost but being part of the same industry, they will possess some overlap in the type of indicators and this further reduces bias for this exploratory research. Geographically, a boundary is set around the Netherlands but articles about developments, statements and such are not geographically limited as they may influence any action in the Netherlands as well. The geographical boundary instead functions as a guarantee for uniformity in sources and in order to dispose of any lag effects between the various indicators over various countries. However, any event that may influence development or action in the Netherlands (and is actually covered in the respective source) is still within the case boundary. Furthermore, the research is somewhat exploratory in nature and therefore in order to approach the research question, it will comprise both **quantitative** and **qualitative** elements in order to answer the "when" and the "how".

3.1 Quantitative Element

In terms of **availability,** I operationalise the following: an increased number of internet domains provides more content and arguably increases the complexity of services. Additionally, an increased number of Dutch domains and services allows, not only for users with relatively little knowledge of the English language to engage in the internet but also increases interest in users that want access to Dutch information or Dutch services provided on the internet. The information on Dutch domains is accessible from the Foundation for Domain Registration Netherlands (SIDN). In the case of mobile phones, an increasing number of mobile phone retailers is a sign of increased competition, increased interest from potential users et cetera; this is likely to result in enhanced services and lower prices as telecom businesses start aiming for a more differentiated market (Tidd, Bessant & Pavitt, 2005). Information on mobile phone retailers can be accessed from The National Bureau of Statistics (CBS) and the National Board for Retail Trade (HBD). Finally, because Personal Computers are complex systems consisting of many subsystems that are impossible to track individually within the boundaries of this research, a quality adjusted consumer price index (CPI) will quickly reveal the trend in technological advance and increased accessibility. The information for computer CPI is available from the U.S. Bureau of Labor Statistics (BLS). Although the source is foreign, the index is a non-dimensional figure and can therefore be applied with less restriction. In addition, the calculation of a quality adjusted CPI is extremely labour intensive and outside the scope of resources ([7]).

The demand, use or **adoption** of a specific technology can be visualised in terms of diffusion. A larger number of adopters implies that it is likely that the technology has penetrated deeper into the fabric of society. Therefore, in terms of indicators, I propose to visualise this phenomenon by researching the percentage of persons that has access to personal computers and the internet as well as the

[7] Bureau of Labor Statistics, Michael Holdway, 16 October 2001, Quality adjusting computer prices in the Producer Price Index: An Overview: *http://www.bls.gov/ppi/ppicomqa.htm*

number of active mobile telephone connections. Note that these indicators are not geared towards households or business for example, as these would be then already biased towards a certain social group which I wish to avoid. This information will be readily available, primarily from the Central Bureau for Statistics (CBS); furthermore, secondary sources such as newspaper articles or specific scientific articles are used to fill out any gaps. If neither is available, the figures will be interpolated or extrapolated.

Expectations as such are difficult to track; however, Ruef and Markard in their papers of 2006 and 2010 propose the use of discourse as a reflection of collective expectations concerning a specific technology (Van Lente & Spitters, 2009). Ruef and Markard (2006, 2010; with reference to Keller, 2005) describe discourses as 'structured and structuring structures'; this fits well in the theme of expectations and statements because "they share the view of a socially constructed reality" (Ruef & Markard, 2006, p. 3). Discourses, that are defined this way offer orientations, meanings and legitimisation in a similar way to expectations as they justify and legitimise innovation activities (Ruef & Markard, 2010). Therefore, **visibility** will be primarily measured by analysing mass media, or more specifically newspapers. Using this type of source serves several purposes; it will be possible to avoid "inflated" attention such as found in media that may be dedicated to the relevant technology (such as dedicated magazines or journals), secondly; using a predefined newspaper will allow homogeneity in the search results because different sources may possess a different bias towards society, technology and technology related news items, lastly; the research is largely geared towards societal integration of a technology, therefore, newspapers are an excellent source of information because they are accessible to all relevant societal actors (households for example) as well as reflecting the relevant interest of society. For this research a single Dutch newspaper with "high editorial quality" (Abbring & Van Ours, 1994) will be used; namely, the *NRC Handelsblad*.

How to identify expectations in articles? Expectations are assumed to contain a "future" component, therefore they will be operationalised as "real-time representations of future technological [or societal] situations and capabilities" (Borup et al., 2006 in: Ruef & Markard, 2010, p.321). Some written statements may not possess the "future" component explicitly, but may still modify future technological situations, these are therefore still considered to be (rather implicit) expectations. The way in which expectations are categorised in detail can be found in Table 4 in Appendix A. Because there are over 27.000 hits for the respective technologies over a time span of 20 years the articles will be approached in the following way as seen below (Table 1):

Table 1: Method of categorisation for newspaper articles.

Article characteristics	Methodology of analysis
Technology in headline (word count <200)	Categorisation based on full text analysis
Technology not in headline (word count <200)	Categorisation based on headline analysis
Technology in headline (word count >200)	Categorisation based on full text analysis
Technology not in headline, one hit in text body (word count >200)	Categorisation based on headline analysis
Technology not in headline, multiple hits in text body (word count >200)	Categorisation based on fragment analysis for hits in context

A database will be constructed for the gathered data. This database spans the research years and will contain adoption, availability and visibility; for each of the three respective technologies (cell phones,

personal computer and the internet). The type of analysis will comprise reconstruction of the discourse in context of availability, adoption and visibility for each respective technology, one at a time. Furthermore, expectations will be categorised into either negative or positive expectations as well as social or technical related ones. The distinction between either social or technical expectations will allow me to trace the nature of the discourse over time. The overview of the collected data is presented below in Table 2.

Table 2: Overview of all quantitative data that will be used for this research.

Data	Description	Indicators
	Availability	
Dutch Internet Domains	"A greater number of Dutch domains and services allows, not only for users with relatively little knowledge of the English language to engage in the internet, but also increases interest in users that want access to Dutch information or Dutch services provided on the internet"	1: The number of Dutch internet domains (.nl), that were registered at the Dutch Foundation for Internet Domain Registration Netherlands (SIDN), from 1990-2009 ([8]).
Mobile Phone Retails	"An increasing number of mobile phone retailers is a sign of increased competition, increased interest from potential users et cetera; this is likely to result in enhanced services and lower prices as these companies start aiming for a more differentiated market."	2: The number of mobile phone shops (franchise based; hence, independent retailers are not taken into account), from 1990-2009 ([9]).
Personal Computers	"A drop in development costs, and consequently consumer prices, will likely result in better access for potential users. A quality adjusted consumer price index (CPI) will be able to reveal the co-evolution of technological advance and increased accessibility."	3: The non-dimensional calculated Consumer Price Index for personal computers, from 1990-2009 ([10])
	Adoption	
Mobile Phones	"A larger number of adopters implies that it is likely that the technology has penetrated deeper into the fabric of society. A technology that has only a few users is thus still alien to most of us, but a technology that is used by everyone, becomes more or less socially accepted. Note that this description befits all corresponding technologies in this section."	4: The number of mobile phone connections from 1990-2009 ([11]).
Personal Computers		5: The percentage of households with a personal computer, from 1990-2009 ([11]).
Internet		6: The percentage of households connected to the internet, from 1990-2009 ([11]).
	Visibility	
Social Discourse	"A quantitative headline count and qualitative analysis of statements and expectations in the *NRC Handelsblad*. Together with the aforementioned building blocks for Availability and Adoption it will be possible to chart the process of indispensability throughout time."	The number of articles written about each respective technology, per year, from 1990-2009 in the Dutch newspaper *NRC Handelsblad*. The articles are categorised along two separate axis, positive-negative and social-technical. 8a: Article count ([12]). 8b: Article count (social, positive, negative) ([12]). 8c: Article count (technological, positive, negative) ([12]).

[8] Stichting Internet Domeinregistratie Nederland (Foundation for Internet Domain Registration Netherlands), SIDN

[9] Hoofdbedrijfschap Detailhandel (National Board for Retail Trade), HBD

[10] U.S. Bureau of Labor Statistics (BLS)

[11] Centraal Bureau voor de Statistiek (Central Bureau for Statistics), CBS

[12] Lexisnexus archive, *NRC Handelsblad* 1990-2009

3.2 Qualitative Element

Because the quantitative indicators cannot describe a sense of quality when it comes to the co-evolution of novelty and needs, a deeper qualitative analysis is also required for this research. Although the study attempts to answer "when" ICT artefacts become indispensable, no tipping point is operationalised. There some are reasons for this; in terms of artefact diffusion for example, Rogers (2002) assumes an S-curve diffusion pattern and mentions that a critical mass may occur when sufficient units have diffused. However, the S-curve is rather static in nature; technology can transform over time as it is diffused, and may even end up having different uses in the end as other meanings are imparted upon it. Not only that, due to the fact that different social groups may give artefacts different meanings at different times (Klein & Kleinman, 2002), it would imply that the artefact may become indispensable at a different time depending on the social group in question. Because of this, it is difficult to assume tipping points, and determine "when" indispensability occurs as a function of just diffusion, availability or attention. Instead, the quantitative analysis is used *solely* to provide additional context for the qualitative analysis; this also allows answering the "when" with more depth rather than providing a "flat" estimate or two dimensional "tipping point".

Newspaper articles only reveal the tip of the iceberg in terms of discourse, but can contain implicit or explicit indications of expectations and routines, and offer a view of the technology in its current relationship towards society or a view of the "socially constructed reality" (Ruef & Markard, 2006, p.3). Thus, newspaper articles with explicit or implicit references to expectations and routines comprise the unit of analysis. These were already gathered in the previous step and placed in the aforementioned database with time labels; ranks, in order to determine their nature (technological, societal), quality (positive or negative); and, colour codes to determine whether they are implicit/explicit expectations; this helps to reconstruct the discourse for each technology. In addition, some written statements will likely contain evidence of routines or their respective evolution; these are then operationalised as statements that contain: explicit mentioning of routines, ritualisation, where the absence of said technology is considered to be a disruptive event, mentioning of micro level practices (the "little things" that people use technology for), et cetera (Hoffman, Novak & Venkatesh, 2004). Routines consequently help reconstruct the patterns of use for each technological artefact.

Finally, the articles are qualitatively analysed in terms of the above as well as their place inside a specific "social groups", which helps identify the different meanings that these may attribute to the artefact. Because the discourse is essentially a large storyline, I will attempt to keep track of the larger narrative throughout the story and keep related articles and discussions linked to each other; this ensures that the discourse does not become an "account of disparate elements" (Keller, 2005). This narrative is then useful for determining the "how". This approach assumes that the discourse in newspapers serves as a vehicle for: uttered statements or expectations that may indicate whether an artefact is currently worth pursuing or worth it in the future; current and future uses or meanings imparted by the social groups that use these artefacts; the mobilisation of resources and actors as well as indications of changing routines and needs; all of which is disguised in a discussion about a technological artefact. Examples of such statements can be seen in Table 3 below.

Table 3: Types of newspaper articles commonly encountered in a preliminary analysis.

Message	Example	Indication
Technology x is indispensible for population y because, ...	"Internet indispensible amongst youths because of their need to maintain social networks."	Usually contains implicit expectations and/or implicit change of routines.
Technology x restructures social interaction	"Communication via mobile phone; sharing pictures taken with mobile phones; chatting with mobile phone."	Usually contains explicit expectations and/or explicit change of routines.
Technology x changes professional and spare time routines	"Computers at work; internet banking; internet holiday bookings; school classes via internet"	Usually contains implicit or explicit expectations and/or explicit change of routines.
The amount of users/ accessibility/ adoption of technology x is expected to grow with amount z per unit of time	"it is expected that there are five million mobile phone connections in the year 2000"	Usually contains explicit expectations.

Naturally, using newspapers in order to construct event patterns has several implications; newspapers possess several mechanism that introduce bias, these are the format of the newspaper, the culture and routines present in the organisational structure of the newspaper as well as the political power and the targeted segment of (potential) subscribers. Finally, it should be kept in mind that no single newspaper can produce an exhaustive set of usable data (Barranco & Wisler, 1999). In order to account for this risk of unreliability, sometimes adding secondary sources will be necessary in order to provide both additional context and accuracy. For this, relevant scientific journals or articles were used.

3.3 Comparison

As mentioned before, the research was somewhat exploratory in nature. Therefore, a comparison between the quantitative and qualitative elements of each technological artefact helped provide additional depth in answering the "how" and "when" of indispensability. This part of the study focused on a qualitative comparison between the artefacts. The elements that were of particular interest at this stage of the analysis are firstly: timing, or the differences in "when"; the speed with which different artefacts reach a state of perceived indispensability; the differences or similarities that may occur due to the various societal domains that are critical for the different artefacts; and lastly, differences in routines and expectations and their difference in impact on indispensability. This allows me to compare points in time "when", and patterns of expectations and routinisation "how" users start attributing quality between each specific artefact. See Figure 2 for a schematic overview.

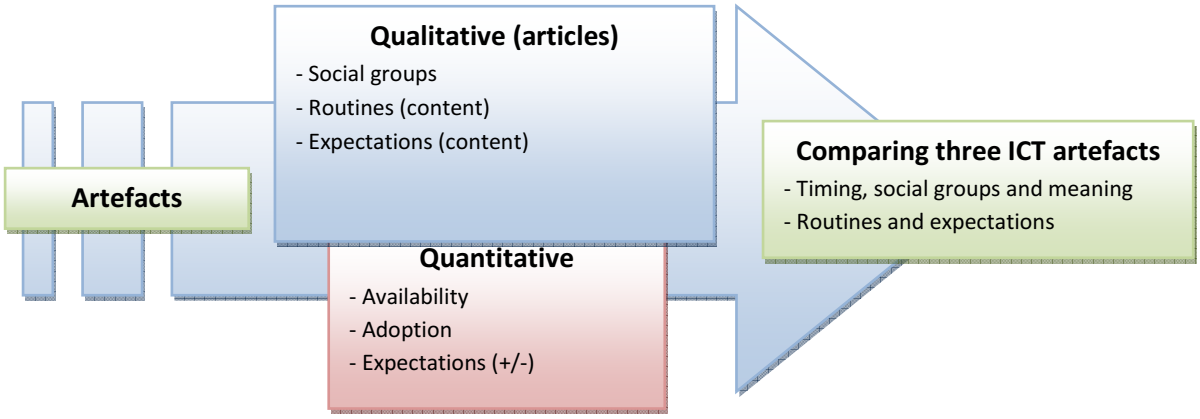

Figure 2: Overview of data analysis method.

4. Results

Case I: The Internet

The history of the future, pre-1990

It is perhaps not surprising that during the course of human history, war has been responsible for a lot of innovations, from the jet engine to atomic power. What few people realise however, is that what we know as the internet since the 1990s, is no exception and started in the late 1950s when the Cold War was far from over. During this time, the Korean Peninsula war had just ended and in 1957 the Russians had launched Sputnik. At the height of this Cold War fever, the United States were fearful over a research gap between the U.S. and the Soviet-Union. Thus, in an effort to regain leadership in various research fields, the U.S. formed the Defence Advanced Research Projects Agency (DARPA, or originally known as ARPA). The internet, being one such offspring of innovations inspired by wartime thinking, was originally conceived as a military application at DARPA, in order to help the U.S. gain a research advantage over the former Soviet-Union as well as connect various strategic organisations such as the Pentagon and Strategic Air Command via different sub-networks (Kuo, 1977; [13]).

As a result of the arms race, the internet is perhaps the most successful example of information technology, which revolutionised the globe and how we communicate today. The internet has become a world-wide broadcasting system where different actors and groups of actors can exchange information, collaborate and interact without the hindrance of almost any geographical or political boundary. Furthermore, the internet has become a cultural, even social-routine and in essence a life-changing phenomenon; it is difficult to comprehend all the changes that the internet has been responsible for over the past few decades (Leiner et al., 1997; Leiner et al., 2009;[13]).

The first conceptual ideas of the internet stem from 1962 when J.C.R. Licklider (MIT) discussed an idea, which he called the "Galactic Network", in a series of memos. The idea described a situation much like the internet is today and formed a basis for further investigation into the subject. Inspired by this idea and an important 1961 paper on packet switching by Kleinrock, dubbed "Information Flow in Large Communication Nets", members of ARPA created the first ever link between computers in 1965. They connected several research mainframes via a telephone line; this is what was to be known as the "Experimental Network" (Leiner et al., 2009;[14]). Following initial success, one of the lead architects of the Experimental Network, Lawrence G. Roberts, filed a plan with DARPA for what was to become ARPANET, the internet's spiritual predecessor (Leiner et al., 2009).

Just a few years after the initial plan, the internet – what is known as ARPANET during this time - comes to life in 1968 with a total of four host computers connected to each other at different locations in late 1969 (Leiner et al., 2009). The 1970s saw subsequent improvements to the internet concept, with the most critical development during this time being the development of the Transmission Control Protocol and Internet Protocol. The TCP/IP is a communications protocol that is still used by the internet today; the TCP is responsible for the quality of service and is concerned with

[13] Internet Society (ISOC), 2010, linked to History of the Internet: *http://www.historyofthings.com/history-of-the-internet*

[14] Robert H. Zakon, 1993-2010, Hobbes' Internet Timeline: *http://www.zakon.org/robert/internet/timeline*

recovery of lost packets and packet flow control whereas the IP is responsible for addressing physical connections connected to the internet. Also, during this time the internet sees practical operational enhancements such as dedicated e-mail software (Leiner et al., 2009;[14]). In the spirit of ARPANET's success, many new networks are created by various scientific and educational institutions. The diversity of networks continues to grow well into the late 1980s with networks such as NSFNET, Bitnet, USENET, UUNET, et cetera. With the transition to the TCP/IP protocol completed in the early 1980s, the internet truly gains momentum through this standardisation; the internet grows from approximately one thousand hosts to more than hundred thousand hosts in less than a decade. At this time, the internet is mostly used for scientific and or military communications for the transfer and exchange of knowledge and information (Leiner et al., 2009;[14]); the World Wide Web as we know it today is not yet conceived.

In the meanwhile, the internet gains some attention in the Netherlands as well. The earliest newspaper article on the internet (or rather computer networks) in the Netherlands is from September 1984 and starts off with an interesting premises, although during this time no-one could have imagined the true impact of the worldwide network just a few decades later: *"The spread of computers is the foundation for what experts believe will become "the true revolution"; spread out groups of local users that are interconnected and will form large global networks. When this happens, the computer user from for example Amsterdam of Copenhagen, can comfortably request such a vast amount of knowledge and information from universities, research institutes, libraries, governments, firms and newspapers that it can be justly called an information explosion"* (26-09-1984, NRC Handelsblad). There is no mention of a commercial application of the internet at this time however, and it is mostly in the context of research and education; this further empowers the previous statement that the true impact is still ambiguous. Also, during this time there are just fifteen internet connections in the Netherlands ([15]).

In the 1980s one of the first networks in The Netherlands is the so-called NLNet; NLNet's mission during this time was to establish network services in the Netherlands. Amongst other milestones, NLNet was directly responsible for the first internet backbone in The Netherlands as well as the first infrastructure for country-wide ISDN. These early provisioning actions by NLNet are directly responsible for the growing impetus of Amsterdam as a major exchange point in European internet traffic ([16];[17]). In the meanwhile, The Netherlands contribute to the European Academic Research Network (EARN) in 1985; this computer network is responsible for the communication between scientific institutions in Europe. The successor of EARN in the Netherlands is SURFnet which, using the previous EARN connections, was to become a world-wide educational and research network ([18]).

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[15] Geschiedenis van het Internet, onwikkeling computer 1984, Centrum voor Wiskunde en Informatica, Mathematisch Centrum, NRC Handelsblad, 26 September 1984, Pauline van der Ven: *http://web.inter.nl.net/users/pauline/InternetArtikel1984.pdf*; original text: *Met de verspreiding van computers wordt de basis gelegd voor wat volgens kenners 'de echte revolutie' moet worden: verspreide groepen lokale gebruikers die aan elkaar worden geknoopt en grote mondiaal opererende netwerken zullen vormen. Op dat moment krijgt de computergebruiker vanuit zijn luie stoel in Amsterdam of Kopenhagen toegang tot zo'n om vangrijke dosis kennis en kunde uit universiteiten, onderzoeksinstituten, bibliotheken, overheden, bedrijven en kranten, dat met recht kan worden gesproken van een 'informatie-explosie'.*

[16] NLNet, 2011, History: *http://www.nlnet.nl/foundation/history/*

[17] NLNet, 2009, Annual Report 2009: *http://www.nlnet.nl/foundation/annuals/2009-annual-report.pdf*

[18] SURFnet, 2011, Twintig jaar grensverleggend netwerken:
http://www.surfnet.nl/nl/publicaties/Overig/Pages/Twintigjaargrensverleggendnetwerken.aspx

The beginning, 1990-1995

As more and more networks become connected to each other, the internet starts taking shape as a world encompassing network; containing somewhere between a hundred thousand and a million hosts ([14]). This statement however, is still quite generous in comparison to the situation nowadays. An analysis of this early situation shows that the number of Dutch people connected to the internet at this time would be close to zero as the first ever commercial provider (The World) only goes online in 1990. Also, it is not until 1993 that the first articles, related directly to the internet, are published. Much more importantly however, it is not until 1991 that scientists at CERN create what is to become the universal language of the World Wide Web, namely: the Hyper Text Markup Language (HTML). At this time, using the WWW is still rather clumsy and without any dedicated browsing software it is difficult to understand for the common user. Furthermore, the internet could only be used somewhat more comfortably and efficiently with the advent of the first true browser (Mosaic) in 1993 ([14]). Finally, in 1993 the first commercial Dutch internet provider (HackTic) goes online; previously NLNet provided internet services in the Netherlands but deemed that the internet would never become interesting commercially and therefore only supplied services to universities and research institutions ([19]). The creation of the first commercial provider in the Netherlands however, is a big step towards general familiarisation of the internet.

But, the internet is still seen mostly as a tool for researchers, students and governments. In this respect it is hailed as a very promising technology but there is very little public interest; instead, "*The academic world starts looking like a global village. Thanks to Internet, a kind of Esperanto for computer networks, students and teachers from 117 countries can communicate with each other.*" (NRC, 25-03-1993). It is interesting to note that the internet is called "Internet" (capital letter) as well as its comparison to a universal language for computer networks instead of being a computer network in itself. Amid the internet's infancy, first mention is made of a "digital super-highway" (NRC, 06-04-1993), and while this term has been popularised in the U.S. by Al Gore, there is little mention of a Dutch digital super-highway; more so, most articles that mention the internet, contain a brief explanation of what "Internet" actually is.

The first true Dutch internet initiative is the public network "The Digital City" or "De Digitale Stad" (DDS) in Dutch; this network is a social-political endeavour that allows digital citizens of Amsterdam to request information about various topics such as party programmes for the coming city council elections, library archives as well as participation in a chat-session (NRC, 28-12-1993). DDS is an important milestone for social acceptance of the internet in the Netherlands as it used terms such as "city" and "citizens" instead of the ambiguous "cyberspace" and "users"; in essence, DDS was aimed at provoking interest from new social groups for the internet, improving computer literacy and in return minimising a potential digital-divide (Rustema, 2001). This is also found in the in the DDS foundation statutes: "providing users with a free internet dial-in access point, policy that targets social groups that lag behind [information haves and have-nots] and finally, support and education of users" (Rustema, 2001, p. 59).

Where in 1993 most people were probably still unaware of the internet, 1994 marked the first year of public interest in the internet, but only so gradually; as articles show, the concept was still largely

[19] XS4ALL, 2010, Geschiedenis: *http://www.xs4all.nl/overxs4all/geschiedenis/*

misunderstood or unappreciated at this time. The Dutch government regards the creation and exploitation of the electronic-highways purely as a "market" related item and regards its role on the internet as a marginal contribution in regulation only. This is in stark contrast with the U.S., where the internet is being embraced (NRC, 27-12-1994). Moreover, the internet in the Netherlands only has 10,000 users at this time (NRC, 03-12-1994); and even in the U.S. there are some that lift their voice in concern: "*David Londoner of Wertheim Schroder calculates that: 'The American super-highway is costing consumers 1000 to 1500 [U.S.] dollars in infrastructure and 400 to 500 [U.S.] dollars in marketing.' He sees the possibilities developing only slowly. Consumers will have to grow towards the new possibilities. According to Frank Biondi of Viacom it will take 7 to 10 years before there is anything like an electronic super-highway: 'Our children will only see and experience a fully realised highway.'*" (NRC, 16-05-1994). In addition, from a social point of view the internet is seen as a threat by some because the freedom to communicate freely will enlarge the gap between information haves and have-nots. Furthermore, the internet is seen as merely hype which the following statements underline; "*there will be not one, but multiple superhighways*", "*there will not be any free competition of services on the internet*", "*the providers themselves will be gatekeepers of the internet and when they are custodian, transporter as well as service tenders at the same time, the temptation to abuse these powers will be profound", "[it is a myth to think that] the information highway will be accessible for everyone"* and finally, the biggest myth according to the article: "*the thought that there is need for an electronic superhighway*" (NRC, 26-09-1994). Another issue that played a role in the early days is in fact due to the early success of the internet in the U.S.; the internet is threatened to splinter into an array of sub-networks again, just like it was before the World Wide Web was introduced. Major players saw 'their' networks emerging as successful and the first steps towards this "de-standardisation" were taken by CompuServe and Microsoft with plans to create their own networks (NRC, 15-11-1994). Even as late as 1997 the Dutch postal and telecom service (PTT) attempted to create their own localised network called Het Net (The Net) (NRC, 07-10-1997).

But not all is bleak during the early 90s; there are also some that have very positive explicit expectations about the internet in terms of its future and capabilities; firms, slowly embracing the concept of the internet, arguably provide a source of speculation about its commercial future: what kind of information do we wish to provide, how many people can we reach and how can we engage in marketing online? Naturally, this commercial debate sparks off hype-like interest from many firms and it is something that no-one wants to miss. It is not hard to imagine that some power-statements may even generate some "bandwagon-panic" as illustrated here: "*[The internet] is not yet a perquisite to run a business, but it could become indispensable in some sectors, just like the telephone.*", or even more explicitly: "*If you're not an internet-citizen by the mid nineties, it's likely you'll be bankrupt by the year 2000"* (NRC, 15-07-1994). It is important to note however that this situation mostly applies to the U.S. still as there are very few Dutch companies commercially active on the internet at this time. However, it is likely that early commercial interest in the internet is spread by these explicit expectations in social media.

The end of the early period is earmarked with both very positive and negative prospects on the internet and no-one is sure where the internet will go from here exactly. One thing is absolutely sure however, the internet-soap bubble has begun; analysis of the *NRC Handelsblad* articles during this time shows telltale signs of this. "Classic"-media institutions such as newspapers attempt to quickly

integrate “new-media”; the biggest being a newly formed joint-venture between eight major U.S. newspaper groups for the creation of an internet platform, in order to spread their newspapers online. This also fuels the first, in a long line, of discussions on whether classic media has any right to co-exist with new media platforms. Further signs are the increasing competition between internet providers and the fight for the quickly growing internet population. This results in a flood of new internet providers by late 1995. However, even the internet providers themselves at this time do not know the look of the internet landscape after the so-called “internet-wars” (See NRC, 11-11-1995), as some believe that every internet provider will provide distinctively different services to every different target market. Also, in an attempt to educate its readers about the new technology, the *NRC Handelsblad* places an article explaining all the internet related jargon such as modem, browser, e-mail et cetera (See NRC, 01-07-1995). While the message itself does not create any expectations as such, social media itself implements routinisation for the understanding of the core concepts of the internet amongst the general public.

But the flood of positively disposed articles continues, with more fantastic expectations appearing, some trying to outdo each other in terms of future prospect. *NRC* articles reveal a steep rise of Dutch firms establishing their presence on the internet, even despite the fact that no-one really understand the internet yet, let alone marketing on the internet; these firms simply want a spot on the aforementioned bandwagon. Expectations during these years finally reach a crescendo with predictions of the internet consisting of a network with over a billion users by 2000. More explicit expectations sketch the following future outlook: “*As a student, you can always take place in your virtual classroom. The doctor is always reachable, entertainment can be requested at any time, as a user you’ll be able to construct your very own newspaper. The virtual store will never close.*” (NRC, 31-10-1995).

In terms of technical developments, a Dutch company creates the first type of online banking. The innovation starts off fairly crude however in comparison to today’s understanding of online-banking; users have to deal with so-called “DigiCash”. The development however opens the way for financial transactions on the internet other than using a credit card and several banks acquire the license for the technology. Furthermore, by late 1995 a substantial European consortium starts of a research project in order to investigate the possibilities for safe commercial transactions on the internet. The impact of this news is hard to miss, it creates new possibilities for the commercialisation of the internet itself and it is likely that this type of possibility piques much interest from commercial establishments.

Not all is a bright future though, more and more voices of concern are raised and they are growing in intensity. Novelty or radical change propels our fear of the unknown; indeed, the concept of the internet being a life and future changing concept raised many issues, some prejudice and some just. Most of the concern regarding the internet is due to its open character and is related to privacy, these discussions are raised both from social as well as technical perspectives. From a technical point of view, the main concern is how to secure the internet against, for example, hackers; and how to secure the internet so that it is possible to conduct safe transactions of information, goods and currency. Socially, there is fear that every action on the internet is tracked and stored and that this information may be abused; in this sense, there is fear of the internet becoming an Orwellian device. On the flipside, many argue that the web is more of a worldwide anarchy: “*The videos containing*

violence and child-pornography on Internet confirm the worst fears. Aggression, commercialism, loneliness and manipulation: media in the future" (NRC, 20-05-1995), "*The internet, that relies on a state of anarchy for its growth, is something that is almost not controllable by definition*" (NRC, 04-03-1995). The lack of regulations and lack of clear responsibilities for all involved parties threaten to turn the internet into a shady mirror society where there are no laws and the internet population can do as they wish. Some expectations regarding this topic are more nuanced or mixed however: "*The discussion about child-pornography and extremism [...] shows that the internet's reputation as 'the largest working anarchy' is under pressure. The lack of enforcement is evident, but it is surprising that there is a need for [social] values in the free electronic space. This makes new media such an interesting development. It is evident that old examples are no longer valid. The electronic highway leads to new [social] boundaries*" (NRC, 18-08-1995); statements such as these provide a more balanced view but it is clear that there is a negative feeling about the quality of the internet in general.

Dynamics in the history of the internet (1990-1995)

Clearly, there is a profound negative undercurrent in the discourse. The concept is largely misunderstood and the rate at which it explodes is a concern for many; the divide between information haves and have-nots, computer literacy and the speed of daily life itself raises many concerns in terms of societal impact. But societal resistance against the internet grows even more as more disturbing social problems are laid bare; many believe that privacy on the internet is non-existent, the internet is a haven for socially unacceptable content such as violent videos and child pornography or that the internet is merely a large junk pile of non-information. Furthermore, no-one knows who is responsible for what; this makes it very difficult to prevent the internet from becoming a world-wide lawless institution. There are many obstacles to be overcome in terms of legislation, exploitation and commercialisation as there are few agreements and a lot more questions to how to approach the internet and what the internet actually is. Furthermore, there are even explicit statements that there is actually *no need* for anything such as the internet and also that people believe that the internet is not actually "the" electronic superhighway but instead, a paved road towards something like an electronic highway. Despite all this, there is plenty of room for positive outlooks. In this sense the internet raises some fantastic expectations about the future and this early championing may have resulted in what would become the internet hype during the following years. It is also possible to draw visible parallels with what Rogers (2003) calls the innovators. Rogers describes these innovators as having a desire for rash and risky undertakings and willing to accept certain setbacks. These types of pioneers can be identified in the analysed articles as the early stock holders in internet shares, key figures that argue that the internet is of "vital" importance (NRC, 12-09-1995) and of course firms that invest in the internet without knowing whether their investments will actually come to fruition. But, both markets and accompanying technology are clearly still in their infancy and are therefore a complex problem to overcome for early internet pioneers; this complex market is also described in Tidd, Bessant and Pavitt (2005).

The analysis shows that there is not just one specific discourse about the internet at this time, but rather several typical ones. This idea is also mentioned in a report funded by the European Commission for the Network for Teaching Information Society (NETIS, 2008) and describes several discourses related to the information society, namely: that the internet is a dystopia, a utopia and either a free-state democracy or controlled dystopia (Orwellian society). The same trend seeps

through in the early discourse analysis of the internet in the Netherlands: the internet is a dump of socially unacceptable content and tries to redefine what is socially acceptable because of the severe content online; the internet provides hope and sketches a picture of a utopian future where the internet provides everyone with whatever they need, wherever they are and regardless of time; and finally, the internet is will evolve in either a world wide-state democracy where everyone can voice their opinions and possess freedom of speech or it may become an Orwellian society, which causes a profound fear of uniting information and society.

One thing is clear however; the internet in itself has little meaning at this time. While the potential for commercialisation of the internet is regarded to be high, this is not based on any factual knowledge (NRC, 06-09-1995); realistically, the internet is still mostly hidden from the general public and only the very first early adopters are active on it. This is further supported by what I defined as availability and adoption figures; "availability" in terms of Dutch internet domains shows 278 registered Dutch domains in 1993, against almost four times as many in 1995 with 1062 registered domains ([20]). While the growth is surely impressive, the number is only very marginal when taken into account that just a thousand people or establishments having taken the trouble to register their internet domain. The total trend can be found in Figure 3.

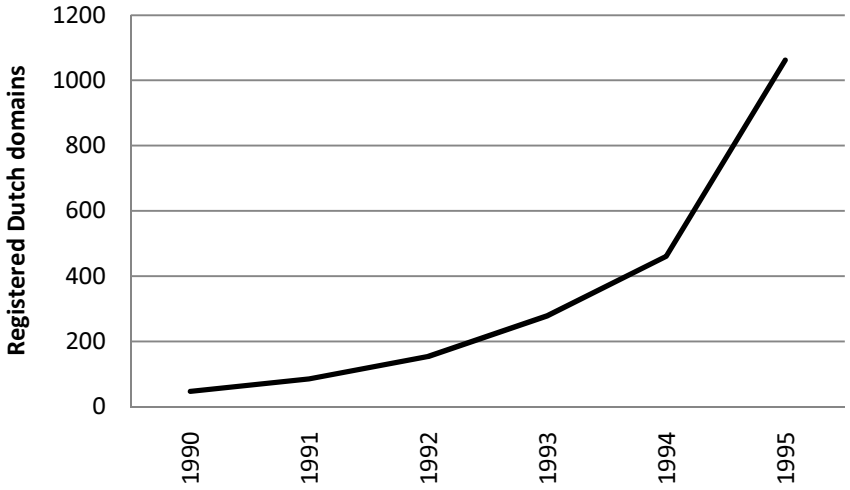

Figure 3: Growth of registered domains in the Netherlands (1990-1995)[20].

In terms of adoption, figures are extremely sketchy but show less than 0,1% of the Dutch population having access to the internet before 1993 to approximately 0,4% in 1994 and an estimated 1% in 1995 ([21]). Figure 4 shows the approximate penetration of the internet in Dutch society as found in the *NRC Handelsblad*. The slow rise in internet use can be attributed to several causes, but one likely to stand out is what articles confirmed before: there is no *need* for the internet; and even so, the current concept of the internet causes much societal resistance to it because of its promoted (arguably disturbing) content.

[20] Registered Dutch domains, 1990-1992: extrapolation from following source, 1993-1995: *http://www.internetten.nl/div/document.asp?id=9593&m=4&kleur=blauw*

[21] *NRC Handelsblad* 1993-1994

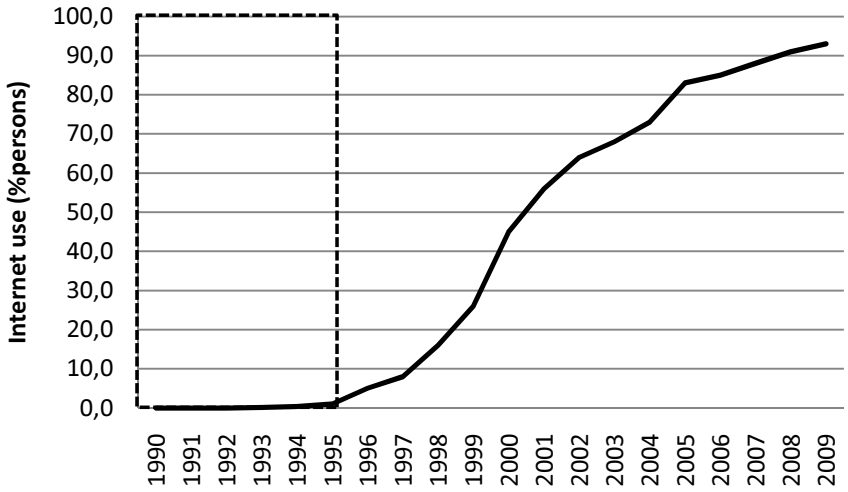

Figure 4: Penetration of the internet in the Netherlands in % persons (1990-1995)[23].

Further analysis reveals that there is very little to no evidence of any routinisation during this time, save for the rather interesting NRC article (01-07-1995) explaining internet jargon, which can be interpreted as an attempt to educate the general public about the coming years, as one thing is definitely sure: it would not be the last that they would see of the internet.

In terms of expectations there are very few to deal with from a quantitative outlook, but there seem to be more overall positive expectations than negative ones. The number of identifiable expectations seems mostly proportional with the growth in number of articles and the expectations that are present are so at a "high" level, mostly concerning general promises or generic societal concern as described by "frames" in Van Lente & Spitters (2009). The generic nature of these frames strengthens the fact that there is still much detailing work left on a proper meaning for the internet. In addition, there are also a large number of mixed expectations and it is unknown what the exact impact of these may be in the longer run. The distribution of expectations for 1990-1995, as categorised during the analysis of the *NRC Handelsblad*, can be found in Figure 5. The total amount of attention the internet received as a keyword during this time can be found in Figure 6 respectively, which shows a steep rise and displays growing interest from the media.

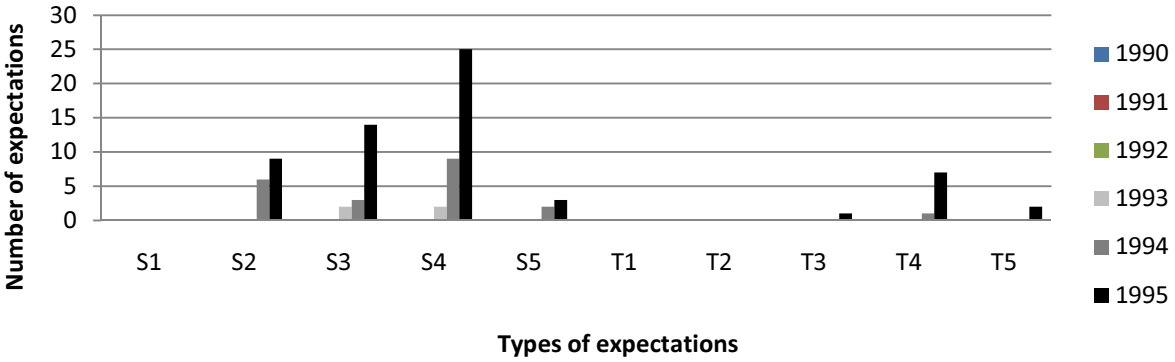

Figure 5: The type and number of respective expectations on the internet (1990-1995).

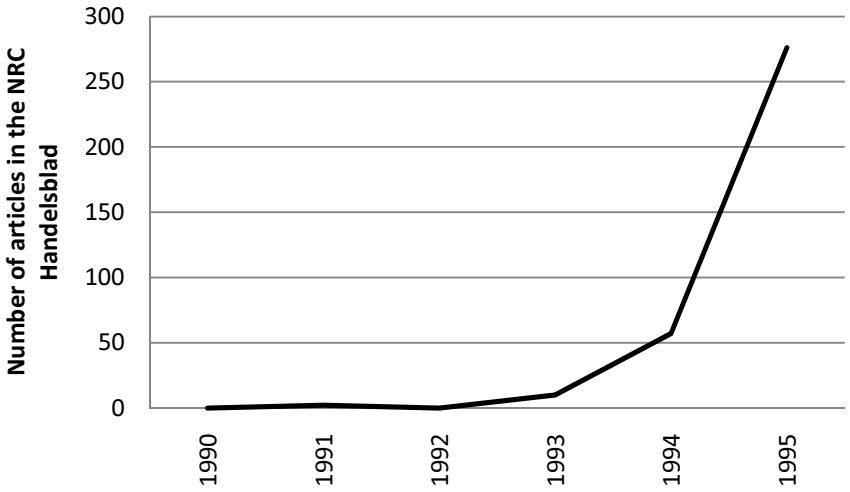

Figure 6: Number of articles in the *NRC Handelsblad* containing the keyword "internet" (1990-1995).

Major growth and the World Wide Gold Rush, 1996-2000

By the beginning of 1996, the internet was a well established topic of discussion in social and political discussions. Its free and revolutionary characteristics were now seen as both a benefit and a threat to society. There were still many that scoffed the idea of actually needing anything like the internet and some considered it to be "opium for the people" (NRC, 09-01-1996). The majority of discussions however, seem to be aimed at the provision for a regulatory framework for the internet in an attempt to ban or severely disrupt the tides of socially unacceptable content. It is for the first time, since the inception of the World Wide Web, that governments take a real interest in inhibiting the totally anarchistic nature of the internet. It is a major subject of discussion just how free the internet should be and where responsibilities lie for all of the involved actors. Not only that, the internet also forces re-thinking existing the distribution of content, and moreover, the distribution of copyrighted content which at this time presents some issues for publishers; here, the free spirit of the internet where anyone can upload and view information conflicts with current copyright laws.

But the anarchistic nature of the internet is not just something that causes major headaches in terms of questionable or copyright content; although often hailed as a powerful democratic tool in modern society, responsible for "democratic landslides" (NRC, 19-04-1997) and opening a window into the world of politics for citizens (NRC, 29-11-1997), the internet is also seen as a major threat for the national security of states that possess a closed character because of its anonymous character and the possibility for people to say and write what they want. It is not difficult to imagine that this enormous potential in freedom of speech is warily observed by those in power; the internet possesses a power to rally people like never before, a power that would be so aptly demonstrated in the future ([22]). Because of this, several nations decide to pre-emptively take control of the flow of information within their borders. The first nation to question the internet's potential is China: "*Does the free access to international computer networks undermine the power of the state? That is the question that has kept Chinese authorities busy for the past couple of weeks. Following the party decree of the last day of last year, where it was determined that the computer network 'Internet' can*

[22] I refer here to the Iranian peace protests of 2009 (The Daily of the University of Washington, 2009, Iran protests: the internet comes of age, *http://dailyuw.com/2009/6/22/iran-protests-internet-comes-age/*) as well as the peace protests in Tunisia (BBC, 2011, Tunisia protests: cyber war mirrors unrest on the streets, *http://www.bbc.co.uk/news/world-africa-12180954*) and Egypt in 2011 during the draft of this research (BBC, 2011, Egypt severs internet connection amid growing unrest, *http://www.bbc.co.uk/news/technology-12306041*).

have dangerous consequences for the 'spiritual purity' of the Chinese people, the cabinet in Peking has created a set of rules to control access to the net." (NRC, 27-01-1996). Following these Chinese initiatives, member states of the Association of Southeast Asian Nations (ASEAN) and Singapore agreed to control access to the internet in an attempt political and "unwanted" content (NRC, 09-03-1996; NRC, 15-09-1996). At the same time, a major discussion at this time taking place in the United States is whether to censor unwanted content from the internet and thus inhibiting certain freedoms; that same year however, a courthouse in Philadelphia ruled that internet censorship is unlawful and in conflict with the constitution (NRC, 13-06-1996). Naturally, this does not include criminal content as the production, facilitation and distribution of this is prohibited by law.

The years leading up to the internet hype are characterised by negatively tainted discussions and expectations about, amongst other things, privacy. These mostly concern the distribution of personal information in the future and the ease with which people can be located, the issue on secrecy of correspondence in relation to e-mail. Not only this, the internet in relation with a digitised government and social institutions such as insurance companies are at the base of negative expectations and borderline fear of an Orwellian society; this is best reflected in a discussion about the introduction of a so-called digital patient dossier. The general discourse, which possesses a negative stance during this time, also covers internet security issues and reveals that there are still too many potholes when it comes to electronic commerce and that security in general is still regarded more of a feature rather than a responsibility for many firms (NRC, 12-11-1999). The technological vulnerability of the internet is also cause for alarm as the late 90s see the introduction of the first high profile and equally destructive internet viruses and worms; malicious strings of code that can deal any type of damage and range from harmless to devastating. Analysis of the *NRC Handelsblad* shows mention of 42 articles in 1999 and 2000 on different viruses and related technological vulnerabilities, compared to 11 articles from 1990 until 1998. In addition, the spread of socially unacceptable content is still a hot topic. But, law enforcement agencies are finally catching up and the late nineties see some of the first police actions as a result of the spread of illegal content. However, there are difficulties because of the international character of the internet and national law falls short in this respect.

Furthermore, because of the required skills, equipment, the speed of internet services in contrast with offline services, and in combination with the plan of the government to publicise government information on the internet for free (whereas content that is requested offline has to be paid for), keeps strengthening the concern of a digital divide well into the hype years. Interestingly however, the discussion about the digital divide flips during the last years of the pre-hype period. This is clear from these contrasting statements: "*It's clear that via Internet a very selective group gains a head start in the housing market. The most wanted houses are already gone by the time Off-liners receive their housing paper. This is the bugbear of the growing use of information technology by the government and semi-governmental institutions.*" (NRC, 13-09-1996); by 1999 however the tone is different: "*The coming years the difference between haves and have-nots of [ICT] will continue to grow. Therefore, it is necessary that 'traditional' forms of communication will continue to exist.*" (NRC 13-12-1999). Clearly, it is no longer an issue of a few people having benefits from an unfair advantage, but rather a small group that is not taking benefits from new technologies and therefore, old solutions must continue to be provisioned.

In the meanwhile, in an effort to establish a presence on the internet, the Dutch government launches a consortium in 1996 making a large internet based investment in the Netherlands (NRC, 11-12-1996). In addition, the Dutch parliament concludes that the Netherlands should retain their lead position in ICT technology and invest in computer and computer-based education. This is also later highlighted in an article from July 28 1997, where the Dutch government made a call for tenders; the order entails the creation of a network for access to interactive media and the internet in 12000 Dutch schools. Furthermore, the Dutch government vastly increased its own presence on the internet as well and expanded its online services and informative websites. As a consequence, the internet reaches adolescence and is no longer a curious obscurity. It is still very far from maturity at this time, but the period from 1996 until 1999 is characterised by the break-up of a socio-political barrier: from this moment on, the internet has to be taken seriously. Because of these initiatives, the Dutch government also implicitly forced, or rather encouraged the use of the internet for the use of every-day activities. These actions may have further stimulated adoption among early adopters; as the rate of adoption of an innovation can be increased if the use of the innovation is forced upon the adopting unit (Tscherning & Damsgaard, 2008).

Although the internet endured some negative expectations during the second half of the 1990s, the public interest, even though tempered, remained. Renewed enthusiasm was finally found in 1999 and within a very short period of time many new companies embraced the internet. The interest in the internet on the financial stock market was a concern for some, but the majority definitely took part in the euphoria. New internet companies were springing forth constantly, and even announcements that existing companies would invest in internet activities became synonymous with suddenly rising stock values. Not everyone was equally enthusiastic, but by now, even the sceptics had to agree on the fact that the internet was being used more and more (NRC, 11-05-1999). The word wide population of 'netizens' was on a constant steady rise throughout the years and this provided commercial establishments with interesting perspectives; investments and trade on the internet, as well as the expectations and predictions of an exploding e-commerce business (NRC, 30-06-1999), served as a background for an impending internet hype. By this time, 70% of the smaller Dutch business was using the internet (NRC, 07-08-1999). Although E-commerce was on the rise vastly even in the Netherlands, and actually doubled within a year, the number of internet users was growing slower than initially predicted (NRC, 03-09-1999). Nevertheless, the change that technology was bringing was becoming apparent and there was little question that the current trend would continue towards full acceptance of the technology by society: "*The paperless office never came to fruition, but the paperless letter is well naturalised. E-mail has become an integral part of the modern office and the private use is on the rise, too.*" (NRC, 22-05-1997); and not much later: "*E-mail, Internet and the cd-rom change the way of communication in society and with it, perhaps society itself.*" (NRC, 18-09-1999).

The late 1990s are characterised by a massive rise in possibilities and services on the internet, but the general public sees no need for these and their subsequent use is limited. Companies attempt to "force" their internet related innovations upon customers by a slow transition to online services and, in the meanwhile, removal of physical services as is the case with banks and the subsequent advent of online banking for example (NRC, 15-04-1999); retail trade and supermarkets are slightly more nuanced but believe that the internet will profoundly change consumer behaviour and therefore these establishments heavily experiment with online services; some commercial services even

provide special discounts for online users. The amount of physical possibilities on the internet and what consumers could do with it increased vastly; whether it was booking holidays; buying groceries, books, cds or anything else found on the internet; looking for information; instant-chat with friends through the newly development instant message technology and subsequent communities; to online-banking, the internet could do it all, increasing the value of the innovation itself. In contrast however, society is trying to catch up with the internet rather than running headlong into these newly offered services. In fact, research showed that the internet use actually simplified and most users limited themselves to e-mail and (financial) news services (NRC, 24-03-1997).

Despite the slower-than-anticipated-growth however, another interesting development took place: a change in demographics on the internet. Before 1999 the overwhelming majority of internet users were young, educated males. In 1999 however, there was a rise of 40% in female internet users (NRC, 03-09-1999). This reflects changing social structure on the internet itself, towards compatibility with beliefs and values found in society. This process is also the start of wider diffusion of the internet throughout society and is further reflected in the following statement: "*Although the World Wide Web is still visited mostly by highly educated males and, by this time also, females, in contrast with the lower societal circles; this new cultural inheritance is unmistakably diffusing throughout a wider societal base. This is exactly the reason why the internet has become so important. Those who have access to the people, possess mass.*" (NRC, 16-09-1999).

Although the internet has grown slowly but steadily until mid 1999, values and beliefs between those found on the internet and society reached a state of agreement. The result was a dramatic growth of internet users from late 1999 to late 2000 and by mid 2000 almost half of the Dutch population and Dutch firms were connected to the internet, compared to roughly a fifth in early 1999. This did not go unnoticed in society and the subsequent discourse reflects this: "*Never before has the use and acceptance of a new technology grown as quickly as is the case with the internet. Seven years ago there was just one way for private individuals to go online.*" (NRC, 01-05-2000). The rocketing value of internet stocks and the exploding growth in users even caused a state of euphoria within the Dutch government itself; this resulted in major plans with propagandistic statements such as: "A computer for everyone, supported by the state.", the Dutch government seemed to, quite suddenly, go digital *en masse* (NRC, 25-04-2000). Surprisingly, the digital divide seemed to close somewhat and even the poorer segments of society were steadily acquiring personal computers for internet use; this segment was growing at an even faster rate than the richer segments. In addition, it was no longer mainly a question of a knowledge based divide in relation to computer illiteracy, but rather an economical divide which would close quickly once technology became cheap enough for everyone to procure. (NRC, 4-5-2000a; NRC, 4-5-2000b). On the contrary however, the part of the population that was not yet active on the internet thought that the internet was a difficult medium and appeared to be nothing more than hype. For these people, the internet was both too complex and too expensive.

The introduction of cheaper and more equivalent flat-rate services and technology such as ADSL also caused a change in dynamics and allowed easier access to the average consumer: "*We think that internet can breakthrough with the average consumers because of this technology; internet is still slow, but with ADSL-technology the internet becomes so fast that you could watch the NOS news on your computer.*" (NRC, 17-05-2000). Both technological progress and political incentives gave a great rise to the internet in 2000. Another very important development was the incentive by European

governments to further create legitimacy for the internet and make it a right for people to have quick access to it; as was the case in Sweden (NRC, 30-03-2000) On a higher level, the European Commission demanded that EU member states would liberalise their telecommunications market and networks so as to increase competition consequently lowering the price of the internet (NRC, 14-07-2000). By the end of 2000, all negative expectations were overshadowed by a renewed utopian view of the internet and its possibilities.

Dynamics in the history of the internet (1996-2000)

We see a slow adoption of the internet during the initial late 90s; it is likely that – as was the case earlier - the many negative expectations have profound implications for adoption. Of course, one could argue that this slow diffusion is, firstly, due to the fact that the internet is expensive; but this is not necessarily the case as flat-rate internet is already available in 1996 and articles confirm that approximately 150 providers were 'fighting' over potentially new internet users (NRC, 01-10-1997; NRC, 16-09-1999). Secondly, the lack of infrastructure does not seem to play a role because the Netherlands are one of the most densely cabled nations in the world. Lastly, there is no lack of secondary infrastructure; due to the private PC project the personal computer was well diffused amongst households in the early and mid 90s with more than 66% of potential users possessing access to one in 1999. As for modem equipment, this was widely available and most of the PCs in the Netherlands were being sold in conjunction with modems by this time (NRC, 04-04-1996).

Not only this, one of the reasons why the main group of internet user remained homogenous for such a long period of time and growth in users eventually stagnated, seems to be that the internet's incompatibility with current cultural and societal values as well as the negative expectations effectively blocked its adoption among the wider public; Rogers (2003) mentions this in his book and describes this as compatibility (or lack thereof) with values and beliefs. Considering here that the wider public would be ordinary households, it is not a far stretch of imagination that a lot of the offered content in the early period simply seemed inappropriate, and the image of a free-for-all anarchy is not likely to have stimulated this any further.

The interference of governments and lawmakers, as well as the various discussions about the character of the internet not only sparks curiosity for waves of new innovators to "see what the fuss is about", but it also creates legitimacy for the innovation and the subsequent framework of laws and regulations that are tied to this new mirror society; this creates trust for firms to attempt to establish themselves on the internet and creates a feeling of safety for the digital population because it is clear what can and cannot be done within the boundaries of the law. In this sense, the early actions of the government were mostly aimed at making the internet a safer place and protecting providers, firms, consumers and users from malicious practice. Further government actions were aimed at increasing the use of the internet through various incentives at schools, with elaborate network projects, and with households, by liberalisation of the telecommunications market.

With the internet being available to a bulk of society, and beliefs and values in society slowly coming together with those on the internet, there were no more barriers to trying the internet. This is vividly displayed in Figure 7 below, where it can be seen that the growth of the internet remains fairly modest up until 1998. From mid 1999, due to the aforementioned reasons, the internet use takes

off. In addition, the hype causes many firms to establish themselves on the internet and the procurement of domain names takes a leap in these years, this can be seen in Figure 8.

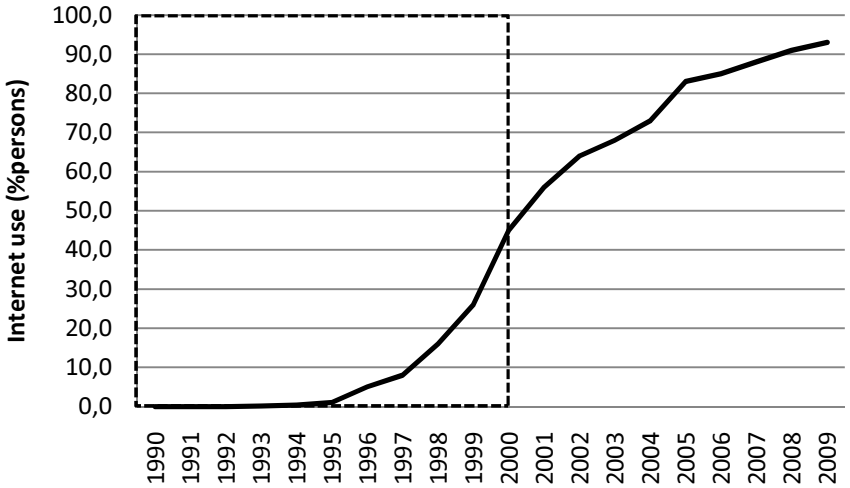

Figure 7: Penetration of the internet in the Netherlands in % persons (1990-2000)[23];[24].

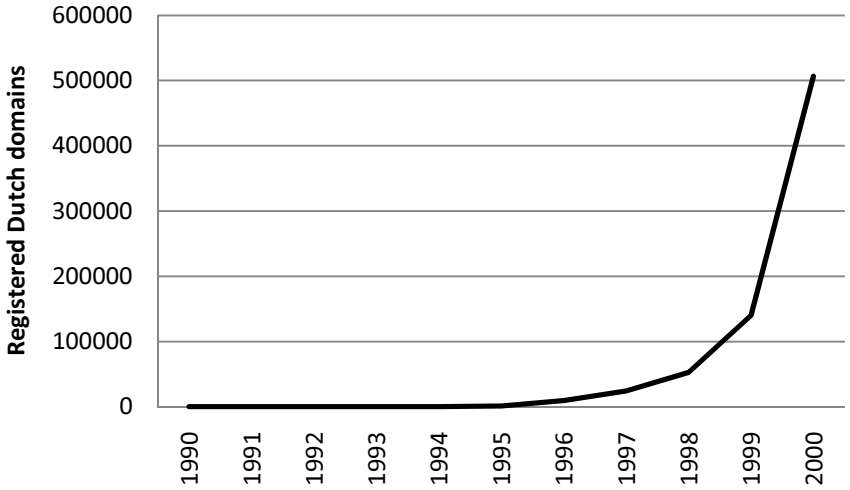

Figure 8: Growth of registered domains in the Netherlands (1990-2000)[20];[25].

Furthermore, the hype aspect of the discourse gave the internet so much attention that it was impossible to ignore it any longer. This can also be seen in the amount of attention the innovation received in the years up to 2000 (see Figure 9).

[23] Up until 1997 there are no documented figures on internet use in the Netherlands, therefore I have estimated its use based on various figures from newspaper articles in the NRC Handelsblad during this time (1990-1997)

[24] Centraal Bureau voor de Statistiek, CBS Statline 2011, Internet use (1998-2000): *http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=70655ned&D1=11-12,14-15,17-52,72-147&D2=0-2&D3=a&VW=T*

[25] Stichting Internet Domein Registratie, 2010: *https://www.sidn.nl/fileadmin/docs/PDF-files_NL/Website%20stats%202010-07%20NL.pdf* (1996-2000)

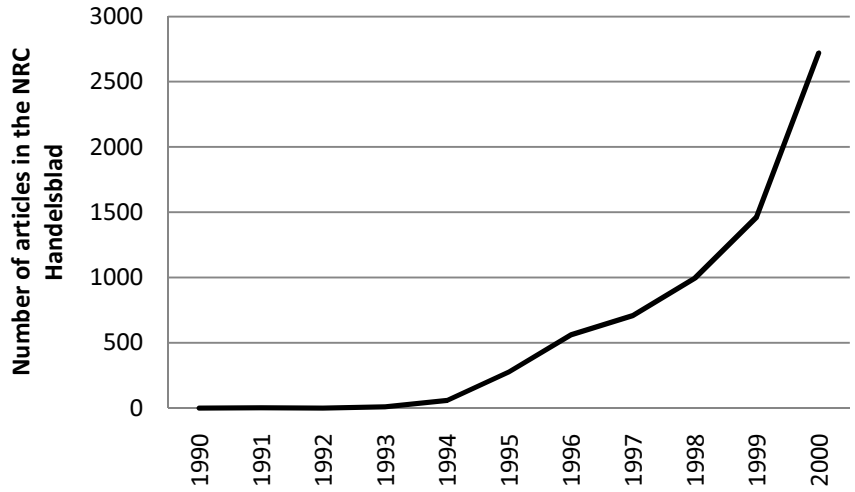

Figure 9: Number of articles in the *NRC Handelsblad* containing the keyword "internet" (1990-2000).

In terms of expectations, there is definitely a vast rise of positive expectations towards the end of the period, as shown in the figure below (Figure 10). In 1998 there were slightly less positive expectations than negative ones, but this is due to the aforementioned reasons: the non-realisation of the initially utopian views, societal issues such as privacy and content and the related deviation from societal beliefs and values. In addition, expectations are still mainly present at "higher" levels during the mid 90s, but with the rising popularity and evolving market they gradually diffuse into generalized expectations mixed with project-specific expectations; or expectations that are tied to products and firms rather than generalised features (Van Lente & Spitters, 2009). This is attributable to the rising number of possibilities that the internet offers and the introduction of new services. From 1999, there is a sharp rise in project-specific expectations due to the related hype.

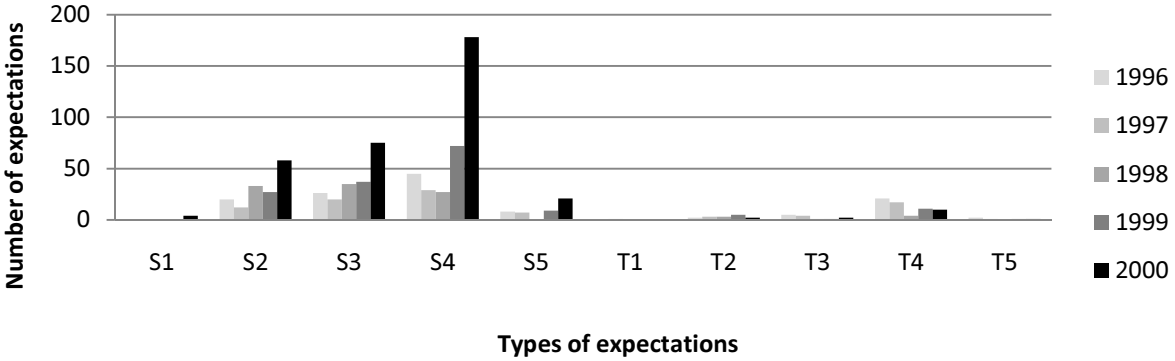

Figure 10: The type and number of respective expectations on the internet (1996-2000).

The discourse reveals that the internet shifts from an innovation without specific purpose or meaning to one with many different meanings and purposes. But generally, the public makes little use of these and instead limits itself to mostly e-mail and information. In this sense, a slow trend towards indispensability is seen, concerning these uses at least. But generally, the internet provides little value for the majority of the population. In addition, the internet has not had it major breakthrough into households yet because of the nature of internet access. The majority of the Dutch population at this time still uses a dial-in connection (exact figures are not known but CBS research from 2002 shows at least 60% of the internet connection to be of the analogue modem type ones).

Furthermore, the creation of new services may indicate some maturation of the internet market itself where it gradually shifts from a complex market to one where novel technologies attempt to satisfy known customer needs (Tidd, Bessant & Pavitt, 2005).

Although both routinisation and domestication are on the rise, routines are not yet so embedded in the general public that there is evidence of a feeling of indispensability should these be disrupted (Hoffmann, Novak & Venkatesh, 2004). However, the internet is becoming more and more important for businesses and in this sense e-mail and internet possibilities are taking over traditional channels, thus increasing their value. The growing use of the internet in businesses results in a disruption of routines when 2000 sees the spread of the first internet-worms. The consequences of reliance on internet and the assimilation of routines linked to the innovation are clear; and without adequate protection, businesses suffer heavily because of the many viruses roaming the internet freely. Thus, whereas email has become routinised amongst business, there is still little routine practice in e-mail security.

After the hype, 2001-2004

After the major internet hype of 2000, the amount of attention the internet received quickly started waning. Not only did the technology end up in a rather typical post-hype trough of disappointment, but major changes in the geopolitical climate were responsible for a shift of interest as well; the most notable shifts being of course the attacks of September 11, 2001 and the subsequent invasion of Iraq and Afghanistan. Despite this, the internet possessed many purposes and new meanings shaped by its users; the process of domestication of the internet could now go well under way.

As the different purposes of the internet started seeping through society it became clear that the internet was undergoing major integration in daily routines. The value of the internet increased with the introduction of many new services and possibilities. An analysis of *NRC Handelsblad* articles shows the mention of: instant messaging, e-mail, online banking and digital transactions, trade, internet home working, search engines (worthy mention: Google), Wikipedia, online shopping, peer to peer networks for music and movie downloads, online user-created-content communities such as YouTube, blogging, online dating, et cetera. Furthermore, the breakthrough and quick diffusion of fast internet subscriptions at monthly fee flat-rate instead of telephone ticks (24% of internet users in 2002 to 49% of internet users in 2004[24]) finally made the internet available to everyone. It is in fact interesting to remark that although the social divide on computer literacy and internet access is closing at this time, a social divide in internet "use" is opening. At this stage of the process the internet becomes indispensable to some, whereas other people can do without in their daily lives; this is important because choosing not to participate in the internet results in losing some of the advantages that it conveys as a whole (Hoffman, 2009). Hoffman even argues that people who do not tend to choose to be "*woven into the larger fabric of global society [...] are not only missing out on key benefits [...] but are in danger of becoming socially, commercially and politically irrelevant in a globally networked consumer society*" (Hoffman, 2009, p. 10).

Because of the assimilation of internet in society and the general acceptance, people also started having certain expectations about online content, it was no longer sufficient to offer clumsy or poor content (NRC, 08-11-2001). If the content was good it allowed distinguishing oneself from the mass. In addition, it also means that the average internet user now started to realise what they want from

the internet. In this socially constructed environment, one article reflects that: "*Internet does not appear to be a medium that changes all cultural differences.*" (NRC, 05-01-2001); despite the seemingly negative connotation, it meant that societies online and offline simply start to mirror each other. Arguably, this may have been beneficial for the internet, as it drives the adoption and domestication of the internet because values and beliefs both online and offline are now compatible (Rogers, 2003).

But the possibilities of the internet also have a drawback. Routines do not necessarily have to be beneficial or even good. And it is probably only a matter of time before a powerful enough innovation is used for the wrong purposes. The internet finally matured and revealed its military potential during the years after the hype: "*The battlefield of the future is cyberspace. According to an American planner: 'During our preparations for the campaign against Iraq, information-operations played an unprecedented role.'*" (NRC, 11-01-2003). Not only did the internet fundamentally change warfare itself, but it also critically changed the way in which warfare is depicted. The years after the invasion of Iraq and Afghanistan show a major increase in online content posted by soldiers and personnel stationed in crisis areas; from human rights issues and daily life, to propaganda, leisure activities and combat itself, in this way, the internet became a rather curious medium that allowed people to interactively experience almost every aspect of war ([26]).

The internet allowed everyone to keep close track of the developing situation in Iraq and the scale of the internet as a news source was unprecedented: from the aforementioned content, to round the clock news coverage and even live coalition forces casualty tracking ([27]). A U.S. study showed that the reliance on the internet as a source of information dramatically increased during 2003, and for many people the internet became a primary source of information. Whereas the September 11th attacks only 3% of American users used the internet as a primary news source, by 2003 this had increased to 37% (Rainie, Fox & Fallows, 2003). These numbers demonstrate the internet quickly maturing to becoming an important, even primary, source of information for many people. On the other hand, all this information provided a source of concern in relation to terrorism was the use of the internet by the "enemy". This subsequently resulted in many discussions about the anonymity on the internet and the exchange of information hat posed a threat to national security. Arguably, it would appear that western governments were attempting to censor content on the internet while limiting the freedom of both information and privacy on the internet (NRC, 09-01-2003; NRC, 22-02-2003; NRC, 26-07-2004; et cetera).

The importance of the internet as a source of social capital was also quickly grasped by the young portion of the Dutch population. Arguably, this is the first real social group within the general population for which the internet became an indispensible technology. Perhaps the earliest example of mass social networking activity and the creation of social capital is the online gaming community. This provided a base for the development of networks and relationships which eventually transformed into (competitive) "clan groups" (online gaming teams) and even friendship; partly based on technical and gaming skills. Although these communities may very well have started with the so-called "nerds" it is evident that the strong growth of online gaming also welcomed youth with

[26] Time, 19 July 2006, The YouTube War, Ana Marie Cox: *http://www.time.com/time/nation/article/0,8599,1216501,00.html*

[27] Operation Iraqi freedom and Operation Enduring Freedom casualties, 2009: *http://www.icasualties.org/*

less thorough technical affinity (Bryce & Rutter, 2003). The growth of gaming as mass online entertainment is also highlighted: "*Millions of youngsters around the world play games with each other on the internet, shooters for example. They play together in groups or 'clans'.*" (NRC, 25-05-2002). It is also interesting to note that research from 2002 showed that 97% of pupils in high school had access to a personal computer; of these, 84% had a PC with access to the internet. Furthermore, almost 60% of youngsters used the computer for social networking activities (NRC, 11-04-2002).

But the importance of networking for youngsters did not stop there. Internet became a new social channel altogether and started replacing old social meeting places in favour of its easy: "*Internet has become what the schoolyard was, for youngsters. From behind the PC new friends can be found and old friendships can be maintained [...] over 30% of youngsters uses chat boxes, or programs such as MSN Messenger, for online conversations.*"; by this time 84% of Dutch youth was using the internet in social networking activities (NRC, 20-10-2004). The internet was becoming indispensable to the Dutch youth; computer and internet access were spreading laterally, from 97% in 2002 in just several age categories to almost complete diffusion (96%) in ages between 15 and 24 years in 2004 (NRC, 20-10-2004). By the end of 2004 however, the internet start diffusing at a higher pace throughout the entire society. Not only young people grasped its full potential, but there was a growing trend amongst people over the age of 50 to incorporate the internet in their daily lives. Published figures in the *NRC* reveal that 52% of people over 50 had now access to the internet, and the total Dutch population with internet access at this time was 76% (NRC, 20-10-2004). This is an enormous growth compared to only six years earlier when just 16% of the Dutch population had access to the internet ([24]). Another factor that may have contributed to social acceptance of the internet is the freeing up of domain registration for private individuals by SIDN in January 2003 ([28]).

Dynamics in the history of the internet (2001-2004)

Whereas years prior to 2000 the use of the internet was mostly accessed by a select slice of society, namely: highly educated young males; the years thereafter were responsible for some major shifts in all-round internet usage and demographics. From a SCOT perspective, there were very few social groups active on the internet during this time and this in turn facilitated little variety in meanings that the internet had, or as Pinch and Bijker (1984, p.414) wrote: "all members of a certain social group share the same set of meanings, attached to a specific artefact". Indeed, the aforementioned portion of society seemed predominantly content with e-mail, searching information, online gaming and news. But as a greater variety of social groups was accessing the internet because its reach increased, a greater portion of meanings was being imparted upon it - thanks to technological improvements in both internet speed and the way with which content was publicised. Furthermore, as meanings are added, it appears that these also add value. In a similar way as value is added in marketing, not only by offering promises but by adding substantial content and superiority over existing products (Kotler et al, 1999), or in this case, existing offline services and routines.

Even though the implications of the internet as a military tool are quite profound as it opens warfare (or in this case, cyber-warfare) on an entirely new plane as well as the fact that privacy and freedom of information was being threatened, it does fairly little to disrupt social acceptance or adoption. Instead, it is merely the political situation itself that limits public attention to the internet at this time

[28] Domeinnamen voor Particulieren: de feiten, 2010: *http://www.webhostinginfo.nl/artikelen/gebruiksrecht-particulieren.php*

(a quick analysis revealed twice as many articles containing “Iraq” and “terrorism” in 2002 compared to 2000). If anything, the seemingly negative expectations about the internet as a tool of war increased its adoption, because the internet provided advantages in at least equal measures; for one, it allowed an unprecedented flow of live information and at the same time providing detail that was equally unprecedented. This abundance and quality of information naturally raises the perceived value of the innovation.

In addition to value, the rate of adoption seemed to be influenced by network externalities, enough adopters managed to adopt the innovation over time creating a critical mass, this allowed the innovation to become self-sustaining. Rogers believes that this critical mass is distinctive to technologies such as e-mail and other interactive technologies because of the interdependence of adopters that it creates. Furthermore, the generated media attention may have caused many users to believe “everybody was doing it”, further driving adoption (Rogers, 2003, p.350); this was more so evident in the rise in internet use in 1999, but the trend continued well into the years after the hype as shown in Figure 11. It is quite evident from the graph below however, that the diffusion of the internet was slowing down somewhat. It is believed that the main obstacle for this was the fact that fast internet technology, although it had broken through, was not yet everywhere available and that the geo-political climate of that time as well as the subsequent economic collapse prioritised other spending above the internet. This situation seems to have stabilised after mid 2003.

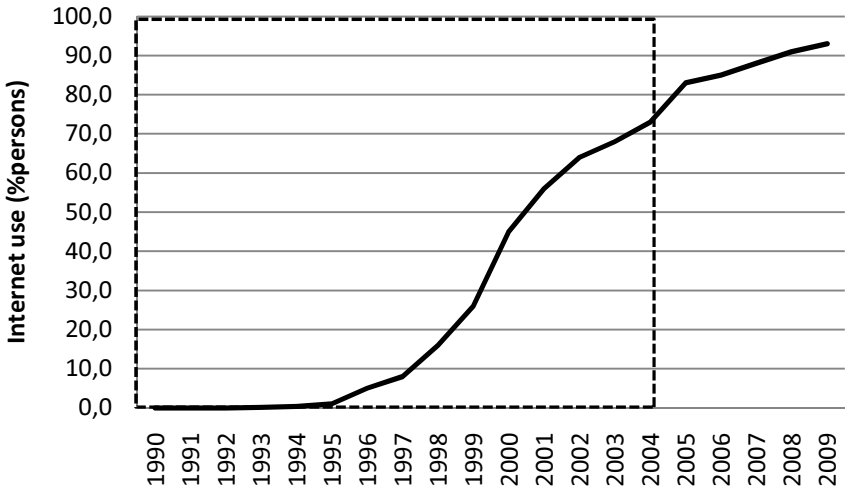

Figure 11: Penetration of the internet in the Netherlands in % persons (1990-2004)[23];[24].

Domestication of the internet was equally on the rise and entered a new surge after the hype period when more and more private individuals started registering their own domain names as this possibility was freed up by SIDN in 2003 ([28]). This is in contrast with the apparent saturation of commercial domain name registration up until that time. After this period, the number of registered domains starts rising more steeply; this is shown in the figure below (Figure 12). The growth in internet domain registration clearly shows interest from private individuals that feel comfortable enough with the internet to acquire their own domain and set up their own websites and online services; hence, showing increased domestication.

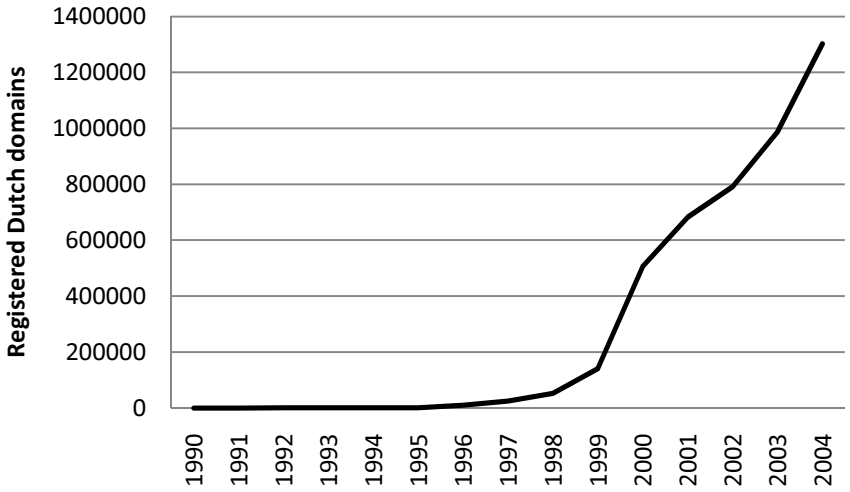

Figure 12: Growth of registered domains in the Netherlands (1990-2004)[20];[25].

The attention pattern (Figure 13) followed a clear hype and subsequent trough of disappoint. There is undoubtedly some backfire from the hype, but the changing geo-political climate likely played some partial role, too. From 2002 on, we see a characteristic "slope of enlightment" (Van Lente & Spitters, 2009); it is suspected that several forces are active here: firstly, the growth in the number of meanings attributed to the internet by an ever increasing number of social groups; secondly, the possibility for private individuals to not only act as consumers online, but rather also producers of information or services; lastly, the possibility for private individuals to secure a private space on the internet.

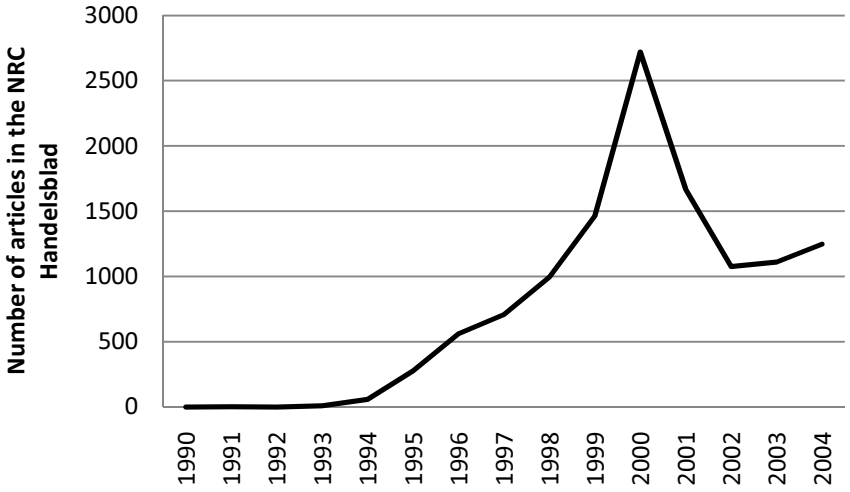

Figure 13: Number of articles in the *NRC Handelsblad* containing the keyword "internet" (1990-2004).

It seems that another important development was taking place on the internet due to the maturation of instant messaging technology and the conception of social network related technology such as weblogs. *NRC Handelsblad* around this time mentioned that the internet was actually becoming indispensable to youth because it allowed them to maintain and construct new social relationships. The internet started replacing older routines of interaction amongst young people; or as one *NRC Handelsblad* article mentioned that the internet was replacing the schoolyard as the prime gathering spot for social interactions (NRC, 20-10-2004). The internet allowed building,

maintaining and storing social capital much more efficiently than real-life. This creation of *social capital* by the internet is well recognised (Frissen, 2004; Hoffmann, 2009) and although this process was actually still in its infancy; it would become much more visible after 2004, when the first interactive social networking services such as MySpace and Facebook would gain popularity.

In terms of expectations, there is decline in positive expectations from 2001, but this is possibly related to the general decline in attention. There is a rise in expectations that are technology related however due to a rise in newly developed services over time. The contextually negative technological expectations are due to privacy concerns and continuously new vulnerabilities such as hacking, viruses and worms. Overall there is a slight rise in generally positive expectations towards the end of the period. The negative expectations are generally "high level" expectations showing general concern about the internet in both societal and technological aspects. Thus, the negative expectations focus on broader societal problems. In contrast, the positive expectations seem to be mostly related to the quality of services and new services that are being introduced. See Figure 14 for an overview.

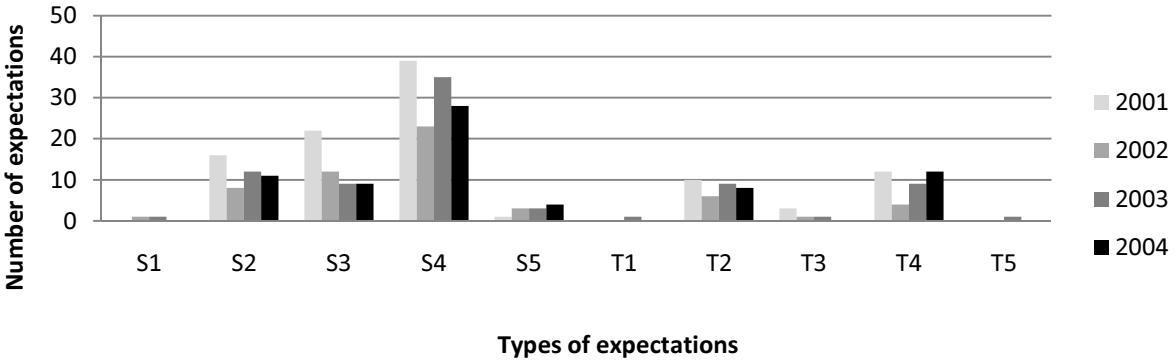

Figure 14: The type and number of respective expectations on the internet (2001-2004).

Unification of information and society, 2005-2009

The signs of the unification of information and society were very well visible by 2005. Results of several studies published in the *NRC Handelsblad* revealed that by the end of 2005 the internet had become unmistakably indispensable. It is maybe difficult to imagine in the current zeitgeist, but it is important to realise that only a decade ago society was absolutely fine without this innovation and that the innovation itself still had little meaning to the vast majority of people, as vividly displayed in the aforementioned discourse from this period. Then, just five years later the process enters its final phase: "*Dutch population cannot do without the internet [...] research by TNS/NIPO and webwereld.nl shows. It was a confirmation of what everyone already felt*. *The website of the [Dutch newspaper] Algemeen Dagblad nailed the everyday character of the internet: Internet is more important than a refrigerator. The internet replaced the fridge and the television as the most important household appliance. For whom is a live without e-mail, Google or marktplaats.nl [online market place] still imaginable? A shrinking minority.*" (NRC, 26-11-2005).

Furthermore, the digitalisation of society and true unification between both online and offline societies could be witnessed online. To put this into perspective, by 2007 there were tens of millions

Skype callers, YouTube visitors and TripAdvisor-inspired travellers world-wide, every month ([29]). Digital information surpassed offline information in terms of importance because the vast benefit of online content was that it could easily be found. Scientific articles and publications were mostly digitalised and Google was quickly becoming the most important gateway to information on the internet for many people. Information that was not available online was in danger of being perceived to be lost or non-existent; in other words, offline information was second-rate compared to information on the internet (NRC, 10-12-2005). This outcome was probably only natural because the internet allowed for a quick diffusion of information amongst individuals; and it was also the birth of a new phenomenon: wikinomics; or how to harness the collective creative and collaborative force of countless individuals (Rinaldi, 2009). Society as a greater entity was now shaping the information age, Time magazine in 2006 even wrote that: "*'[the internet created] community and cooperation on a scale that humanity has never witnessed before' because of services such as the online encyclopaedia Wikipedia and social networks such as YouTube and MySpace.*" (NRC, 18-12-2006). The way in which society was shaping the information age is also evident from the way in which civil journalism was on the rise due to, amongst other services; Twitter (NRC, 29-11-2008).

Although technology that facilitated social activity had become popular, such as e-mails in businesses and instant messaging amongst youth; the perceived power of social networking was spreading amongst the entire internet population with a new hype: blogs. Weblogs proved to be a powerful societal tool and the number of blogs quickly rose to many millions. The weblogs were dubbed "a new form of personal communication" (Rosenbloom, 2004 in: Du & Wagner, 2006) and served as a primer for individuals to establish relationships or exchange ideas, views or knowledge (Du & Wagner, 2006). The spread of this networking technology can be easily seen in discourse of that time, the weblog spread quickly amongst creative individuals, hobbyists, politicians and even scientists. Although the weblog was immensely popular for a short while, it was eventually superseded by social networking sites that gained much popularity by the later years of the 2000s. Although initially again used by youth, the social networking sites eventually diffused amongst the entire internet population. In this sense, older social networking routines were replaced by new ones as the new technology was capable of retaining closer social contacts and still allowed for the same functionality as weblogs (NRC, 16-09-2009). The immensely rising popularity of these social networking sites indicated that the creation and maintenance of social capital proved to be one of the prime functions of the internet. Not only this, social networking increased the power of the people in states with questionable agendas, as mentioned earlier; social networking sites are partly responsible for the mass of protests in Tunisia and Egypt in 2011, but they were also surgical in allowing people to gather and voice their opinion in Iran; some called this the "Twitter revolution" (NRC, 11-04-2009; NRC, 30-06-2009).

However, in the internet's power as a social tool also laid several dangers and in this respect it was truly a mixed blessing: "*Internet is a blessing: communication, the exchange and organisation of information has never before been this easy. But the internet and computer provide their share of problems as well. [...] There is too little discussion about the addictive aspect. We experience it ourselves daily: quickly check for mail, Skype a bit, search for a little more information. [...] The new generation is growing up with the computer, and [online] availability creates addiction*" (NRC, 05-02-

[29] Wikinomics: How Mass Collaboration Changes Everything, A.D. Williams, IT@Cork, 28 November 2007: *http://www.itcork.ie/contentfiles/eventresources/AWilliams.pdf*

2007). As important however, was the character of online-bullying which was due the anonymous nature of the internet which allowed individuals to anonymously send messages, post stories, pictures or even videos about the victim. In addition, the anonymous and seemingly boundless character of the internet allowed bullying to take more serious forms than in real life. Even more pressingly however, it quickly becomes routine practice: "Bullying has become common practice for [41% of] youngsters" (NRC, 17-03-2006); "*Online-bullying is just as harmful to children as "ordinary" bullying: 'The consequences of which can be depression and attempts at suicide'*" (NRC 22-03-2006). In response to this, several campaigns were launched in order to draw attention to this rising problem, and while being an often discussed topic during the mid 2000s, the matter seemed to draw towards the background by the late 2000s, but the problem appears to exist still ([30]). A deeper rooted social problem was that of "social virology"; violence is contagious and in this sense the mass media – and as a consequence, the internet - facilitates copycat behaviour. The increasing amount of violent texts and images brought into circulation could potentially urge other people to partake in violent actions (NRC, 06-05-2009). Indeed: "Recent episodes of school shooting, whereby the perpetrator recorded a message and then disseminated it through the Internet, indicate that school shooting perpetrators desire that other people understand their reasons. These expectations indicate that the behaviour is supported by a recurrent pattern. [...] The media and reports on the Internet could facilitate the diffusion of these potentially lethal norms" (Preti, 2008, p. 547).

In addition to social networking, online gaming became extremely popular during the late 2000s. Although previously online gaming with dedicated genres was popular; the internet because of its evolution in speed and content also allowed reasonably complex web based games. These were quickly becoming a very large internet market. In addition to the dedicated genre of the massive multiplayer online role playing games (MMORPGs) which served tens of millions subscribers respectively, the – by comparison - simple web-based games drew more than two hundred million players monthly world-wide, half of which are female (NRC, 16-04-2008; NRC, 21-11-2008).

Marketing on the internet also entered a new era with specific targeted marketing and behavioural commercials. This allowed to specifically targeting those individuals that showed certain behavioural characteristics on the internet or on the basis of beforehand known traits such as sex or income; which may range from the websites they visit to small words in emails they send or receive. This type of very direct marketing is a big change from the earliest forms with random banners and buttons. It indicates that commercial establishments feel comfortable on the internet and know how to approach their target groups via tailored marketing. Naturally, this raises several privacy concerns, but the Dutch privacy watchdog "College Bescherming Persoonsgegevens" has not acted upon this type of marketing since (NRC, 13-11-2008). In addition, the battle for the social networking user is in progress, here established services such as MySpace and Facebook fight on both provided service, substance and quality which indicates a differentiated market where technology and market are both mature (Tidd, Bessant & Pavitt, 2005; NRC, 12-02-2008; NRC, 11-12-2008).

A large portion of the subsequent discourse in the late 2000s was dedicated to privacy; the discussions on privacy were approached from a wide range of angles. Whereas from a technological point of view it was through that internet services were still vulnerable to: firstly, data-mining which

[30] SpitsNieuws, 18 February 2011, '#deomeisje' leidt tot commotie:
http://www.spitsnieuws.nl/archives/binnenland/2011/02/deomeisje_leidt_tot_commotie.html

for example would involve tapping into phone conversations that take place over the IP protocol or Voice over IP (VoIP) (NRC, 03-02-2005); secondly, phishing: a practice which involves the creation of duplicate websites based on genuine counterparts. The web-address to these false duplicated would then be emailed to any number of users with the request to login because the organisation or service required the verification of user login data. Once an unsuspecting user would login, the user's data would be stolen and criminals could now potentially access the user's genuine website (NRC, 05-08-2008). Lastly, trojans: these would allow remote control and access to computers of unsuspecting users (NRC, 24-08-2008). From a societal point of view the discussion on privacy took equally many forms: while people were concerned about data in the hands of corporations and organisations but they themselves were unperturbed about the information they themselves left behind on the internet which could result in identity theft, blackmail or other malicious practices (NRC, 14-06-2008). Another concern was that many youngsters were unaware that once content was placed on the internet it was almost impossible to remove all of it as it is continuously stored and could roam for years afterwards. Naturally, this was a concern as there seemed to be somewhat of a trend, where young people would post intimate content about themselves online (NRC, 09-05-2008). All in all, privacy was an important subject throughout the later years and a keyword analysis shows that at least 93 articles related to privacy on the internet were published between 2005 and 2009.

The impact of the internet on old media was another recurring point of discussion throughout the years and intensified once again in the late 2000s. The general discourse was aimed at the possible disappearance of old services such as newspapers and television. The so-called Brinkman-commission judged that old media were in dire need of subsidisation if they were to survive; this conclusion resulted in some interesting recommendations. Namely, said internet users should be held responsible for this and in order to sustain the old media, they would be forced to pay a fee on top of their internet subscription (NRC, 23-06-2009). Needless to say, this proposal has not yet been implemented. In addition to the disappearance of media, there was some discussion about the possible disappearance of postal services due to economic circumstances but also due to the internet (NRC, 04-07-2009). It is evident that the internet raised much sentiment and that it forced many established organisations to re-think their strategies and thus, re-think as well as modify their existing routines.

Dynamics in the history of the internet (2005-2009)

By the mid 2000s the internet was very well absorbed within society and by 2009 the internet was basically all around us; this is clearly evident with 93% of the Dutch population having access to it by mid 2009 (see Figure 15). The internet possessed a profound meaning within society and the advantages of the internet were also recognised by the later adopters. In addition, what may have also caused the adoption of the internet reach such a high level of diffusion is that existing services were slowly being replaced by services provided on the internet. One example is the high level of government services available on the internet by this time, which of course was more convenient than physical forms; indeed, offline information was becoming second rate compared to online information. Furthermore, because the internet now had so many adopters, it was very beneficial for new users to connect to it. One of the most prominent drivers for being connected to the internet at this time seemed to be not only the value provided by services, but also the power in maintaining social capital in an unprecedented way. It is also evident that during this time because of the plethora of possibilities, the internet homogenised throughout society more and more and in terms

of present social groups, reflected society more realistically than it had done before. There were business possibilities, networking, financial services and communications for businesses; online gaming, entertainment, education, social networking for the younger population; social networking, online shopping, information, news, casual games and information for households and of course information, social networking and other services for the older segment of society. While the internet had already become indispensable to certain social groups many years earlier, it was now indispensable throughout almost the entire of society.

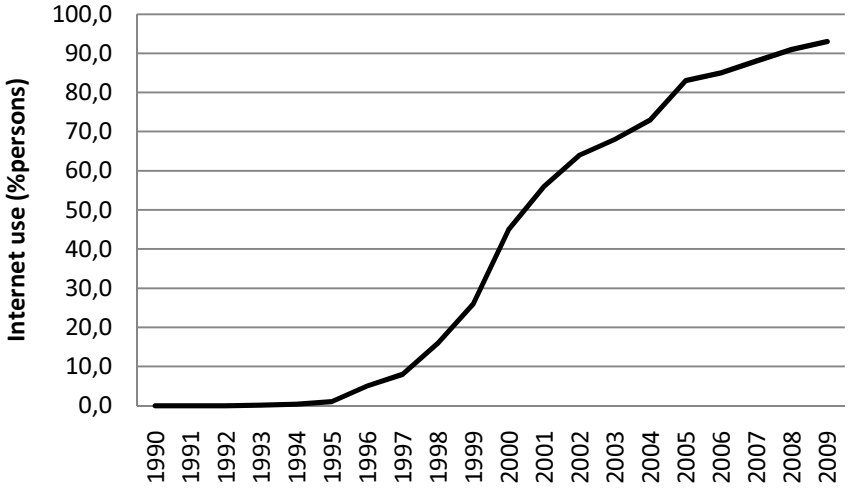

Figure 15: Penetration of the internet in the Netherlands in % persons (1990-2009) [23];[24].

In terms of availability of online content we see a very steep continuously rising trend. From 2005 to 2009 the number of Dutch domains almost doubled. This would indicate that there were also a larger number of Dutch internet services available to the population. However, the numbers also imply that it was very well accepted to construct a personal website. The urge to possess a part of cyberspace not only tells us that this was a popular practice, but also that, in light of the general discourse, that online presence was valued. In fact, going by numbers alone there was a Dutch domains for every one in four people (see. The quick rise in registered domain names also shows that during the 2000s – especially when SIDN allowed private individuals to register domain names – the internet had acquired a great deal of acceptance and meaning from society.

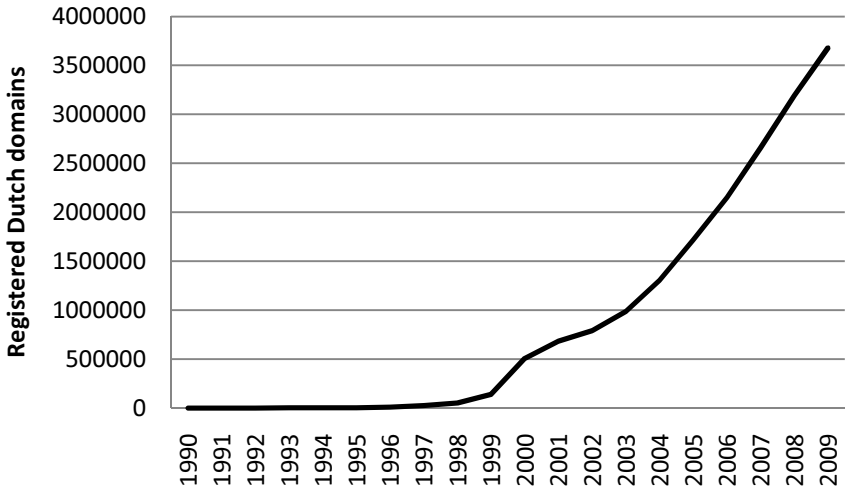

Figure 16: Growth of registered domains in the Netherlands (1990-2009) [20];[31].

In terms of visibility, the attention for the internet flattened out mostly. It is also evident from the general discourse that many of the articles were rather impersonal. In fact, mention of the internet became very casual and a great deal of anecdotal references existed. Consequently, the number of explicit expectations also stagnated. Compared to both diffusion and availability, it can be seen that visibility did no longer affect either one. The concept of the internet was well enough diffused throughout society in order to sustain itself. Visibility of the internet is shown below in Figure 17.

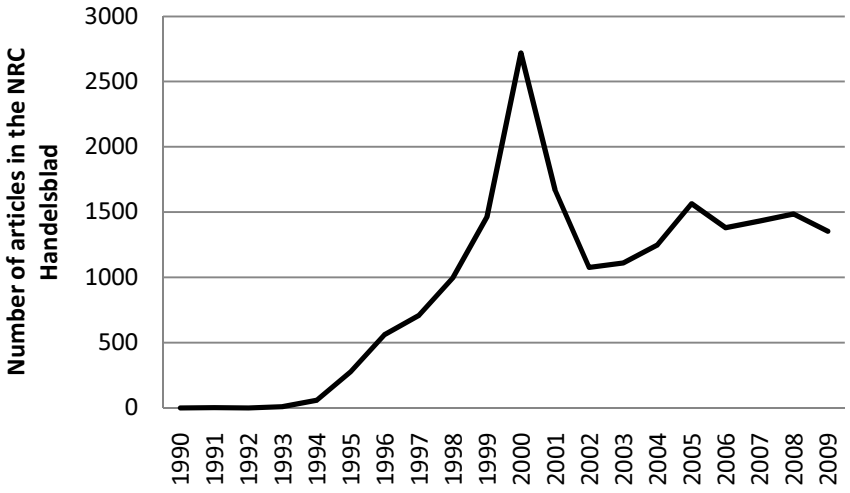

Figure 17: Number of articles in the *NRC Handelsblad* containing the keyword "internet" (1990-2009).

Despite the negativity of some portion of the discourse, this does not seem to affect adoption or availability (anymore). An analysis of the *NRC Handelsblad* articles shows that in terms of routines, these negative statements and expectations have an impact because many various actors try to improve on the security of the internet in both technological and societal aspects. In the technological field there is a constant improvement of services to make them safer and counter malicious practices such as the aforementioned "phishing"; in addition, existing services may opt to provide more privacy options or enhance the security of their systems. In the societal domain, the

[31] Stichting Internet Domein Registratie, 2010, *https://www.sidn.nl/fileadmin/docs/PDF-files_NL/Website%20stats%202010-07%20NL.pdf* (1996-2000)

population becomes aware of the possible risks that the internet poses and allows them to modify their existing routines in favour of more secure ones; such as, opting to post less private content online, install firewalls and virus scanners or in the form of education, against for example online-bullying (See for example: NRC, 06-09-2008). Over time this also reveals a changing trend in how difficulties and challenges, for which the internet is responsible for, are solved. Up until the late 90s all these questions resulted in a dilemma whether to adopt or not.

After adopting the internet, the dilemma was seen shifting to legitimacy and regulations; finally, the different challenges are approached on a "micro" scale by all involved actors. Here, the micro-scale refers not so much to a few individuals, but rather, a few simple initiatives by many. This furthermore demonstrates that expectations and statements contain a performative power and that they interact with the innovation over time (Borup et al., 2006). Indeed, they do not seem to lose their performative power over time. The results show not only replacement of old routines by the internet, but once the innovation became domesticated thoroughly, old internet routines start being replaced by new and more efficient ones. Such as the transition from social communities based on weblogs to true social networking sites. As the internet and its meanings were completely diffused throughout society and routinisation entered its next generation, the distinct identity of the internet started to wane. The complete assimilation resulted in more anecdotal references and accordingly less and less explicit expectations over time; this trend is visible with the decreasing number of expectations over time as shown in Figure 18 below.

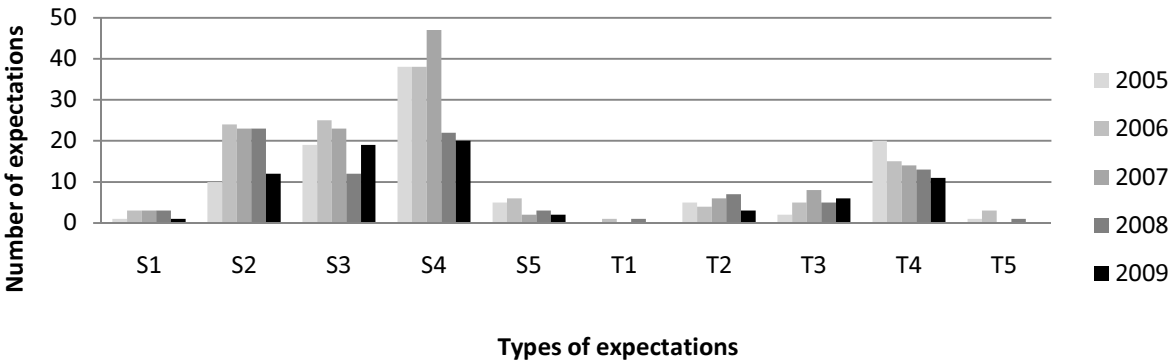

Figure 18: The type and number of respective expectations on the internet (2005-2009).

Case II: Mobile Phones

Communications and mobility, pre-1990

Just like the internet, mobile communications have a longer history than one would realise. The mobile phone or more accurately, mobile telephony services appeared in the late 1940s. However, the technology was yet in its infancy during this time and "mobile" telephones were extremely cumbersome due to their weight, power consumption and size. The first practical application of the mobile phone was in Sweden for Swedish police and rescue services; the technology was so power hungry however that it could drain a car battery after just six calls ([32]). It would not be until the mid 1960s that the technology would improve sufficiently. Earlier breakthrough in electronics meant that the old vacuum tube technology could now be replaced by transistor based equipment. Transistors drew less power and weighed a lot less than vacuum tube based electronics and so more practical "mobile" phones appeared in the late 1960s; these still required a car to comfortably move them around (Lacohée, Wakeford & Pearson, 2003).

In the late 1960s the technology for "mobile" telephony was available; however, technical difficulties between handing off calls from one cell area to another prohibited users from continuing calls after they had reached a certain distance from the base station. These cell areas are nothing more than geographical areas that are served with mobile phone frequencies by a base station. The hand-off problem was solved in 1970 with the advent of the call hand-off system; mobile phone users were now able to move from one cell area to the next while making a call ([32]; [33]) In the late 1970s the U.S. introduced the first working example of mobile telephony when the Federal Communication Commission (FCC) authorised AT&T Bell Technologies to install a cellular phone system. The sheer size of the U.S. presented many problems for further development however, and so the Nordic countries (Scandinavia & Finland) took the lead. By the beginning of the 1980s there were tens of thousands of mobile phone users in Scandinavia alone, higher than anywhere else in Europe (Lacohée et al., 2003).

The following years numerous small innovations to the technology would be made and in 1983 the first ever truly mobile phone was introduced by Motorola. This first generation (1G) of mobile phones was still rather cumbersome and primitive compared to modern mobile phones and the first Motorola mobile phone weighed almost a kilogram ([32]). Nevertheless, mobile telephony saw an increase in use, and although most telephones were still too large and heavy to use by hand comfortably, the term "car-phone" enjoyed increasing popularity. Much of the mobile phone technology was still analogue and by the late 1980s it was decided to embark on the development for standards of the second generation of mobile phones (2G). This development would lay the foundation for the Global System for Mobile telecommunications or GSM, which eventually saw widespread use in Europe and other parts of the world (Lacohée et al., 2003).

The societal outcast (1990-1995)

Despite projections from 1985 by the Dutch Postal and Telecommunications Services (PTT) that showed that only fifteen thousand of these car phones would be in use by the beginning of the

[32] TopBitz,com, 2011, History of Cell Phones: *http://www.tech-faq.com/history-of-cell-phones.html*

[33] U.S. Patent 4,144,411 -- *Cellular Radiotelephone System for Different Cell Sizes* -- Richard H. Frenkiel (Bell Labs), filed Sep 22, 1976, issued March 13, 1979

twenty first century, car phone use increased far more significantly than anticipated. During the beginning of the 1990s there were already a hundred thousand car-phone users in the Netherlands alone. Because of the quick increase in users, the first Car Phone Net (ATF-1) originally provisioned for 2500 subscribers was already full. Even the second ATF (ATF-2) introduced in 1984, with provision for 32.000 users, could facilitate no more new users. As a result the PTT quickly introduced ATF-3 by 1989. Naturally, the large number of different networks posed problems for users of the various networks, as ATF-1 could be used in Germany, Luxembourg and Austria, but at the same time, subscribers from ATF-2 could not use services in Germany and instead were able to make calls in Belgium. The lack of a real standard in mobile telephony was a major hindrance for its further diffusion and the transition to the digital GSM network would be a welcome one (NRC, 23-06-1990).

During the early 1990s the mobile phone seemed to function mainly as a symbol of status and there is some evidence within the *NRC Handelsblad* articles. Articles involving impersonal statements about mobile phones are characterised how mobile phones have become a routine in some upper class, political as well as criminal circles (NRC, 03-07-1991; NRC, 07-12-1991) This is also partly due to the price of mobile phones at this moment; an article from 1991 shows that, the cost of a mobile in 1990 was around 9000 Guilders (€4100) and although it dropped to approximately 4500 Guilders (€2050) a year later, it was still well out of reach for the average population (NRC, 04-01-1991). In the meanwhile, the PTT maintains a strict monopoly on mobile telephony networks in the Netherlands and was forced to abolish its related monopoly on the sale of mobile phone equipment only a year ago. While the monopoly on mobile telephony networks is guaranteed until 1994, the abolishment of the monopoly on the sale of (mobile) phone equipment resulted in increased competition on the sale of the respective items. Consequently, prices of mobile phone equipment dropped quickly; however, Philips and Motorola managers argue that the mobile phone is still too much of a luxury and status phenomenon. The Netherlands are well behind Scandinavia in terms of acceptance of the mobile phone and there are only approximately 4 connections per thousand inhabitants, whereas Norway and Sweden possess 46 and 53 respectively. The mobile phone is only expected to "break through" once the price in the Netherlands drops to approximately €800 which is not likely to occur within the next year (NRC, 04-01-1991; NRC, 13-02-1991).

While the mobile phone is gaining a lot of popularity in the U.S.: "*The number of mobile phone subscribers in the U.S. has doubled in the past three years and there is no indication that this grow will diminish [...] there is a 'true revolution' in telecommunications going on*" (NRC, 17-08-1993), and the market is open and full of competition (NRC, 12-01-1994) discussions on a potential competitor for the PTT in the Netherlands continue well into 1994. Many Dutch banks are interested in acquiring a second license for mobile communications at this time and although the reason for this is not explicitly stated in the articles themselves, it is possible that this is due to the fact that most of the mobile communications at this time are still performed in business circles (NRC, 02-10-1992).

Finally, in June 1994 the Global System for Mobile telecommunications (GSM) is launched with great festivities by the PTT in the Netherlands, this is an important milestone because it is a major step towards standardisation of mobile telephony in Europe (NRC, 30-06-1994). Standardisation is of course important for the acceptance, legitimacy and diffusion of the product because it lowers the perceived risk for consumers of acquiring the wrong standard (Robertson & Gatignon, 1986). Naturally, the deployment of the GSM network is coincided with some rather positive expectations,

in terms of technical advantages over the older existing ATF networks the GSM network is more flexible and consumers have a greater reach from the base stations as well as greater coverage. In societal terms the mobile phone is even expected to increase work floor productivity (NRC, 30-06-1994). In addition, the PTT expects 1.8 million mobile phone users by the year 2000. Despite this, the mobile phone keeps struggling with its acquired image and remains an object of ridicule throughout the early 1990s (NRC, 12-11-1994; NRC, 18-11-1994).

The first change in social perception of the mobile phone only slowly appeared in 1995. While the mobile phone was at first cautiously greeted, the projections for mobile phone use are being constantly revised upwards (NRC, 15-03-1995; NRC 08-06-1995). A large amount of hope is placed on the future competition between mobile phone providers in order to reduce prices for consumers and make the technology more widely available. Currently, the mobile phone is mostly popular in business related environments where the business people and travellers greatly value the mobile phones' connectivity. While regular consumers in the Netherlands remain sceptical, expectations are that general acceptance of the innovation will commence fairly quickly, especially when the prices for mobile phones and subscriptions will drop due to competition and technological developments (NRC, 15-03-1995). The initial steps towards the first major growth of mobile phone use would come quicker than anticipated however; amidst discussions of possible competitors for the PTT and the reduction of subscription costs, mobile phone use starts to increase. The Dutch provider Libertel eventually becomes the first competitor to the PTT and where mobile phones cost approximately €4500 less than five years earlier, mobile phones were now sold for less than €25 in combination with a subscription. The new marketing strategy where mobile phones were sold in conjunction with a subscription proved to be advantageous: mobile phone use started to increasing ever faster; with an increase in mobile phone subscriptions of 65% for the PTT in 1995. Competitor Libertel even acquired 25.000 subscribers in just three months (NRC, 08-12-1995; NRC, 21-12-1995). The combination of accessibility and availability meant that the mobile telephone was no longer a luxurious obscurity and started gaining social acceptance.

Dynamics in the history of the mobile phone (1990-1995)

The early discourse on the mobile phone shows that it is mostly regarded as an obscenely expensive luxury. Therefore, diffusion of the mobile phone during the early 1990s remains very low; only the richer segment of the population can afford access to the innovation. There is little question about its use however, and business people quickly discovered its benefits in terms of connectivity and "keeping in touch" with businesses and other contacts. Thus, it would appear that the innovation possesses initial meaning, but the societal barriers for its use remain high. Firstly, very few people can afford it; and secondly, the users are scoffed at because of the innovation's image as a "yuppie" item. Use of the mobile phone would remain fairly low throughout the years due to the prices in mobile phone technology and related subscriptions; approaching the mid 1990s however, the introduction of a competitor to the PTT as well as the vastly dropped prices for both mobile phones and subscriptions consequently increased use and interest in mobile telephony from the general public. The use as well as demand for mobile phones rose, and this can be seen in respectively Figure 19 and Figure 20.

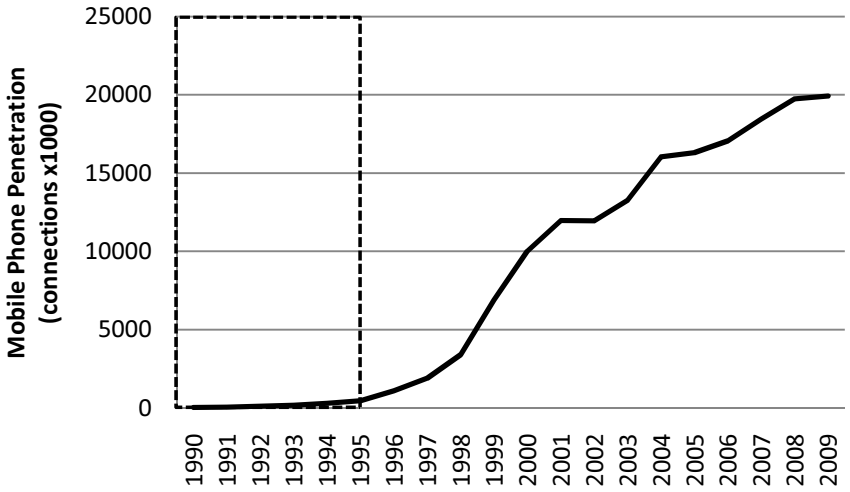

Figure 19: Mobile phone penetration in the Netherlands in thousands of connections (1990-1995)[34].

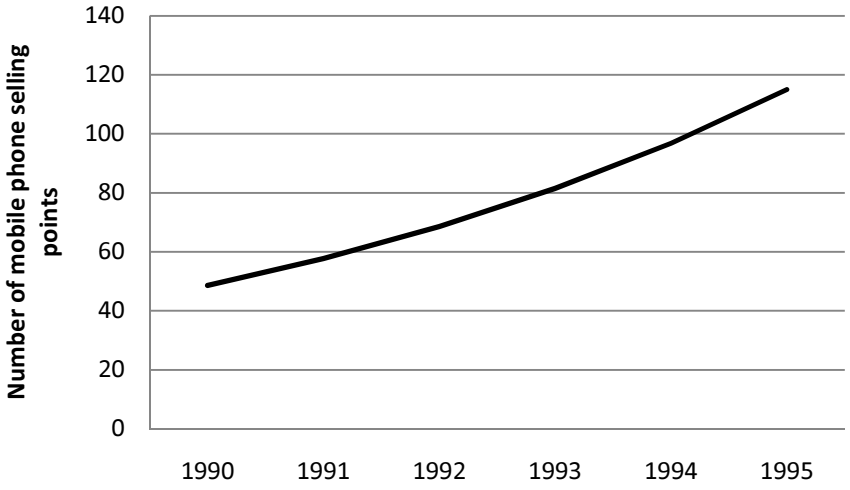

Figure 20: Number of mobile phone selling points in the Netherlands (1990-1995)[35],[36].

The amount of attention that mobile telephony receives in the *NRC Handelsblad* is synonymous with its greater use and demand or availability. Interesting enough, the spur of attention that mobile phones receive only really shows from 1994 when prices for mobile telephony equipment started to drop as a result of technical developments and when competition in mobile telephony was becoming reality. Ultimately this piqued some interest from the social media; following this rise in interest the trend continues when the first competitor to the incumbent monopolist is introduced in 1995 and mobile phones as well as subscriptions become so cheap that they are within reach of the vast majority of the population.

[34] Partial reconstruction from NRC Handelsblad articles (1990-1994) as well as data from the Central Bureau of Statistics (CBS), 2010: *http://www.cbs.nl/nl-NL/menu/themas/bedrijven/publicaties/digitale-economie/artikelen/2007-2214-wm.htm*

[35] Central Bureau for Statistics (CBS), 2010: *http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLNL&PA=03760ed&D1=0,5-16&D2=678&D3=a,l0&HD=100828-1530&HDR=T&STB=G1,G2*

[36] Lack of data from 1990-1994, therefore extrapolated from 1995 CBS data. It should be noted that the number of mobile telephone selling points is thus probably lower in real life during the early 1990s.

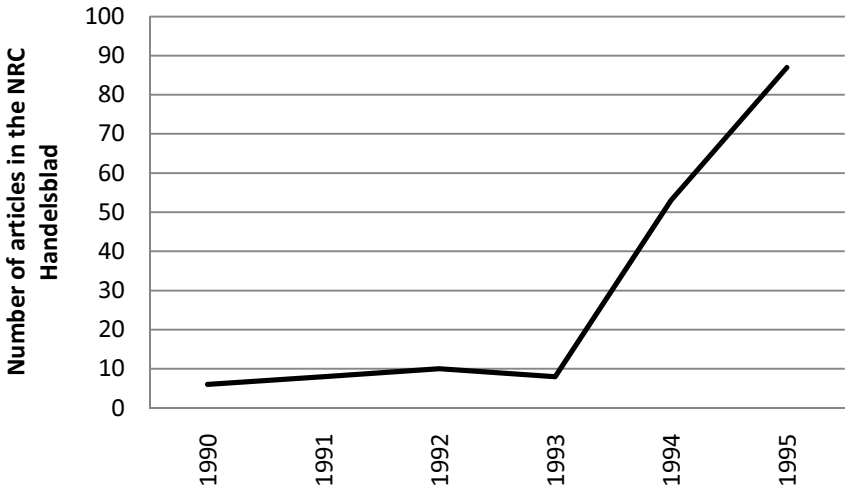

Figure 21: Number of articles in the *NRC Handelsblad* containing a combination of keywords related to "mobile phones" (1990-1995).

In terms of expectations, the situation is overall stable. Mostly present, are high-level overarching expectations and projections about future use. The sudden peak of expectations in 1995 is due to the hype-like character that forms as a result of the extremely cheap (at least in comparison to the situation in 1990) mobile phones and related services. Although their advantage is not yet truly identified amongst the general public and there is no evidence of either routinisation or need, they become available to everyone and this allows a greater portion of the public to experiment and subsequently domesticate the innovation. In turn, they became a popular gift for Christmas in the Netherlands in 1995 (NRC, 21-12-1995).

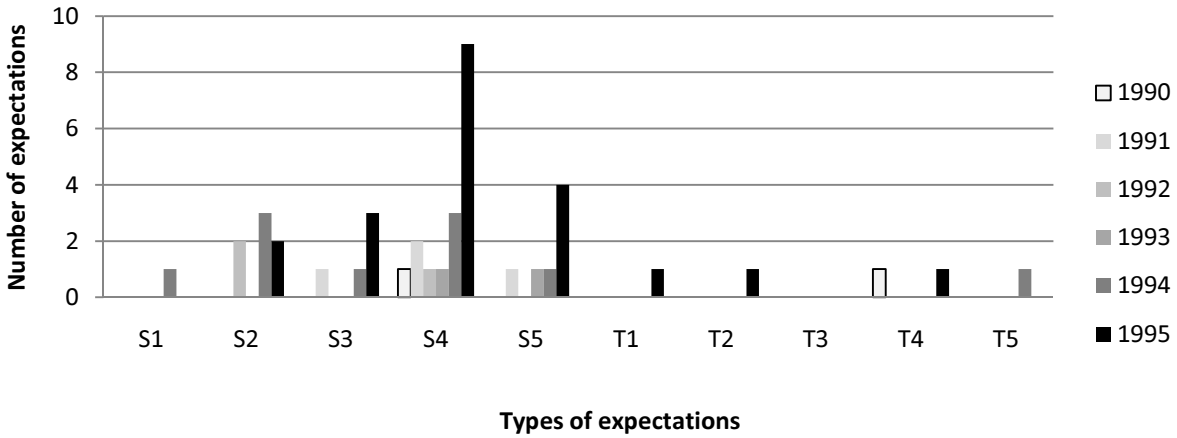

Figure 22: The type and number of respective expectations on mobile telephones (1990-1995).

From outcast to accepted (1996-2001)

The sudden take-off of the trend in mobile telephony in the Netherlands in 1995 continues throughout the following years. Every subsequent year from 1996 previous records concerning mobile telephone use are being kept broken during New Years Eve (NRC, 02-01-1997; NRC, 09-01-1999) and this is also in line with growth numbers of mobile telephony during these years; mobile telephony in the Netherlands eventually reaches more than ten million connections in 2000 (Kool et

al., 2009[37]). Facilitating this development is the urge to auction more mobile phone licences for future providers in 1997. The Dutch government deems this a necessary action in order to further increase competitiveness and lower subscription prices in an effort to differentiate the market. Dutch government at this time wants to be a leader in the infrastructure of digital infrastructure. Consequently, during the late 1990s the contemporary minister of transport, public works and water management provisions space for more mobile phone networks in the Netherlands (NRC, 15-02-1997; NRC, 23-04-1997). These provisioning actions eventually evolve into a total of five major competing networks in the Netherlands by 1999 (Kool et al. 2009).

In terms of marketing, mobile phone providers attempt to draw ever more subscribers by offering free or inexpensive mobile phones in conjunction with a subscription: "*The rise of the mobile phone is unstoppable. With the help of sometimes aggressive marketing, numerous suppliers of mobile phones and subscriptions move ever more people to purchase a mobile phone. With success: there are already more than a million Dutch mobile phone users*" (NRC, 28-04-1997). Naturally, the promise of "free" mobile phones and "cheap" subscriptions also draws many young people into the use of mobile telephony (NRC, 07-08-1997). Because of stiff competition currently existing land-lines and mobile telephony reach price parity in late 1997 (NRC, 16-10-1997); with all the advantages provided by mobile phones over ordinary land lines there is eventually little need for individuals to maintain both. In addition, mobile telephone connection and land line connections are compatible and therefore do not have to overcome any externality conflicts as they can readily communicate with each other. Consequently, these factors are likely to have resulted in mobile telephony slowly replacing land-lines (Rogers, 2003; Pertierra, 2005).

Social resistance is mostly limited annoyance that mobile phones seem to cause. Also called "telephone terror", some innovations are introduced to block the possibility of using mobile phones in theatres, libraries and other public places. Furthermore, opponents call out for some sort of mobile phone-etiquette (NRC, 19-06-1998; NRC, 07-10-1997; NRC, 11-11-1998). Nevertheless, the mobile phone is slowly acquiring its position in society: "*Nowadays, with more than four million mobile phones in circulation, the GSM has become just as ordinary as a washing machine or cheese slicer. Students order a pizza while riding the bicycle, and there are calls from every [supermarket] to ask which cat food the cat at home likes.*"; the use of the mobile phone is slowly becoming routinised (NRC, 04-03-1999). To further assist the spur of adoption and subsequent domestication of the technology throughout different social groups, mobile phone producers allowed the personalisation of the artefact. In addition, shape and colour became important characteristic for different users. This introduced a new meaning for the mobile phone; users would not only consider the technology as a utility but also perceive it as a fashion item. In return, it also allowed mobile phone producers such as Nokia to identify and target different market segments (NRC, 30-04-2001; Rogers, 2003)

Accordingly, *NRC Handelsblad* articles show that mobile phone use jumped from just 4,4 million connections in March to 5,5 million connections in October that same year. This was especially true for younger segments of the population: by mid 2000 at least 90% of people under the age of 25 had routinely used SMS services with their telephones; but the routine use of mobile phones is not only confined to the Netherlands and other European nations see the same trend emerging. In fact, in

[37] Kool et al. (2009), Marktrapportage Elektronische Communicatie September 2009: *http://www.rijksoverheid.nl/documenten-en-publicaties/rapporten/2009/11/01/marktrapportage-elektronische-communicatie.html*

order to participate in the social circles, a mobile phone is almost considered obligatory for young people (NRC, 07-08-2000; NRC, 22-11-2000). Results of an investigation on the use of telecommunications, by people between the age of 6 and 24, were published in *NRC Handelsblad* and revealed that the way with which young people communicate vastly changed in the previous two years. Youngsters make extensive use of new communication possibilities offered by the internet and mobile phones. According to the results, young people use these technologies in order to maintain and expand their social capital. Furthermore, young people consider these technologies to be indispensable for this very purpose. Interesting enough, it is quite the opposite that was predicted a couple of years ago when it was said that social contacts would deteriorate due to these becoming impersonal. However, new communication technologies allowed easier communication and as a result, intensified social contacts (NRC, 21-09-2001).

The late 1990s and early 2000s saw many attempts at integrating different technologies with mobile phones. Some examples of these include the possibility to pay for various rendered services by SMS, mobile phone-based banking and the most promising technology: internet on the mobile phone (NRC, 27-10-2000; NRC, 01-12-2000; NRC, 24-02-2001; NRC, 19-09-2001). Internet on mobile phones was to be facilitated with the help of so-called Universal Mobile Telephone System (UMTS) network technology. This technology allowed greater throughput of data in comparison with existing network systems and was therefore promising as a carrier for mobile internet (Jansen & Nilsen, 2002). Despite initial expectations, the frequencies that were auctioned for UMTS use by the Dutch government were much too expensive (NRC, 10-05-2000). In addition, the telecom business was plunged into a crisis of its own (NRC, 13-03-2001). This resulted in some firms withdrawing from the UMTS project and subscriptions being overly expensive once the service was introduced to the public. Indeed, even previous marketing schemes where new subscribers were drawn to mobile telephony providers with free telephones were now deemed unprofitable and eventually terminated. Mobile telephony providers were anxiously looking for extra income in order to finance the expensive UMTS infrastructure (NRC, 13-07-2001). Furthermore, mobile internet did not become the envisioned need that telecom companies hoped for, and typical mobile applications that were envisioned were too much out of line with the values and beliefs of that time. Consequently, these were rejected by society (NRC, 24-02-2001).

Of much larger concern however in the early 2000s are the possibly severe impacts that mobile telephony has on health. Consequently, there is growing concern over the electromagnetic radiation from these telephones. Research to investigate the possible effect of electro-magnetic radiation resulted in contradictory statements. Some of these statements caused a genuine health scare: critics argued that electro-magnetic radiation might cause Alzheimer's and Parkinson's diseases. Furthermore, U.S. research that was supposedly funded by telecom companies revealed that mobile phones might even cause brain tumours (NRC, 06-07-1999); in Britain and other nations this even led to public inquiries (McGuigan, 2005). At the same time, research portrayed electro-magnetic radiation as something "relatively" harmless: U.S. research showed that radiation emitted from mobile phones may stimulate addictive endorphin production in the brains (NRC, 20-03-1999). In addition, a British study revealed that although electro-magnetic radiation emitted by mobile phones might be harmful to children, the adult population was at least safe from the tissue warming effects of this type of radiation. Moreover, radiation of this type did not seem to show a correlation between any of the severe diseases that were thought to be caused; instead, EM-radiation only

caused subtle biological changes that were considered to be harmless (NRC, 12-05-2000; NRC, 20-05-2000). Nevertheless, European government forced mobile phone manufacturers to adhere to strict radiation standards (NRC, 07-08-2001). Consequently, by late 2001 the health scare seemed to have subdued as no further attention was given to this particular subject.

Dynamics in the history of the mobile phone (1996-2001)

Starting from the mid 1990s the increase in competition on the mobile phone market as well as the constructed subscriptions that offer free telephones, the innovation sees a vast rise in users. The mobile telephone not only becomes affordable to a large segment of society but also becomes trialable as a result of this decrease in price. The innovation is not inherently complex as anyone knowing how to operate an ordinary telephone is likely to be able to operate a mobile telephone. Furthermore, because the mobile telephone already possessed an inherent meaning but lacked congruence between current values and beliefs a change in the telephone's image resulted in the mobile phone receiving acceptance from society. Consequently, the mobile telephone sees an enormous adoption spur in the Netherlands from 1996 to 2001 where the number of users grows by almost tenfold (see Figure 23).

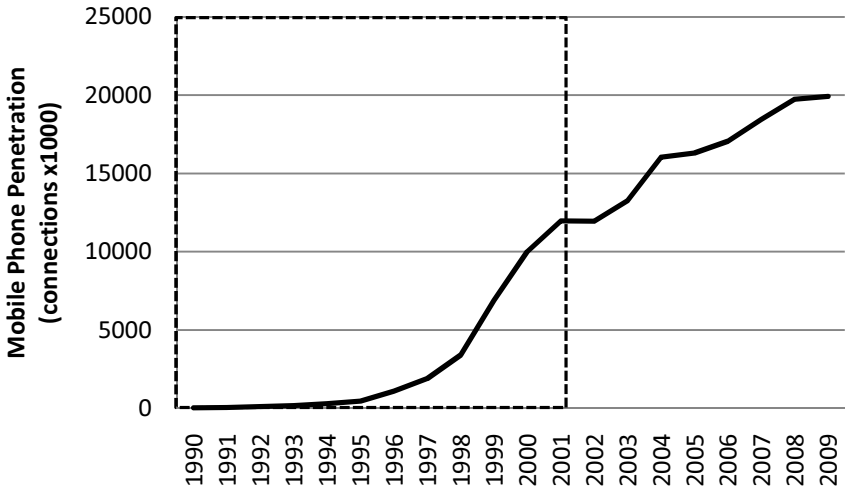

Figure 23: Mobile phone penetration in the Netherlands in thousands of connections (1990-2001)[34, 38, 39, 40].

The increase in number of competitors and the growth of mobile telephone franchises can clearly be seen in Figure 24. The stimulation of mobile telephony by the Dutch government clearly opened the market by allowing more competition. Although even despite the free market the 'availability' of the mobile telephone appears low, one has to keep in mind that it was not until 1999 that the number of main mobile telephony competitors in the Netherlands increased from 2 to 5 ([37]). Naturally, the increasing number of mobile phone selling points also mentioned that the innovation could garner more visibility in general, as well pique interest from potentially new users.

[38] Lack of data, interpolated from 1995 and 1999 data sets in order to reconstruct 1996-1998 period.

[39] Nederland Breedbandland, 2005, Netwerken in cijfers, Kwartaalrapportage mart 2005, Ministerie van Economische Zaken, TNO Delft (1999-2000): *http://www.nederlandbreedbandland.nl/uploaded/FILES/netwerken_in_cijfers_2005.pdf*

[40] Rijksoverheid, Marktrapportage Elektronische Communicatie - TNO - September 2009 (2001-2009): *http://www.rijksoverheid.nl/documenten-en-publicaties/rapporten/2009/11/01/marktrapportage-elektronische-communicatie.html*

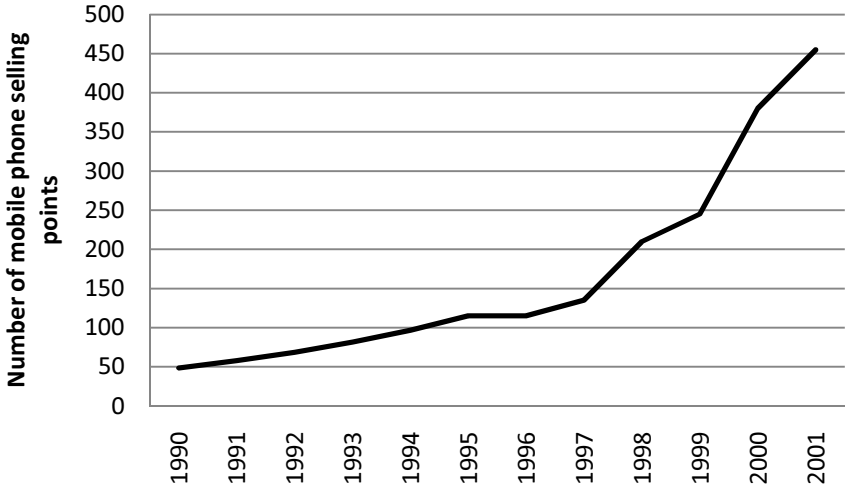

Figure 24: Number of mobile phone selling points in the Netherlands (1990-2001)[35],[36].

Synonymous with the increase in both adoption and availability there is a strong rise in attention that the mobile telephone receives in society. The quick adoption of the mobile telephone also resulted in many social groups quickly considering the innovation to be an indispensable item. As a result, a good deal of articles already mentioned very casual use of the mobile phone by the late 1990s, only a couple years after the market for mobile telephones truly opened to the wider public.

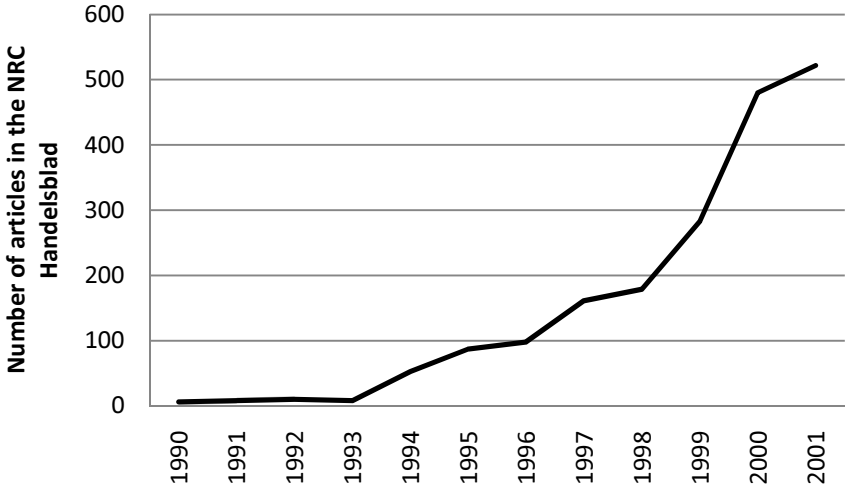

Figure 25: Number of articles in the *NRC Handelsblad* containing a combination of keywords related to "mobile phones" (1990-2001).

Regarding expectations, the mobile telephone receives very mixed expectations, both positive and negative, few of which possess a truly breakthrough character. New technological developments allow for new features in mobile telephones, one example of this is the digital camera integrated in mobile telephone design. Furthermore, the attempt to integrate the internet with mobile telephony soon takes up a part of the general discourse and generated expectations. Nonetheless, due to various factors such as cost and the economical climate, the technology was slow to unroll and the network that should have facilitated comfortable internet on the mobile telephone, UMTS, was subsequently delayed. Naturally, this generated some negative expectations. Some of the most negative expectations during these years are however generated by the health scare, triggered by

the possible radiation from mobile telephones. It is difficult to assess the impact of this on acceptance of this innovation, but the fact that it triggered societal debates and government inquiries means that it possibly had some effect in slowing down the rate of adoption in the subsequent years. Other (mildly) negative expectations were mostly concerned with the degradation of the fabric of society because of the 'tyranny of connectivity' (NRC, 31-07-1997) that communications technology allowed. In general however, the mobile telephone was regarded as a blessing by most, especially the social groups into which it had so profoundly diffused already. In particular the younger segment of society hailed the innovation as an indispensable artefact for the upkeep of their social networks and social capital. This general trend in expectations can be seen in Figure 26 below.

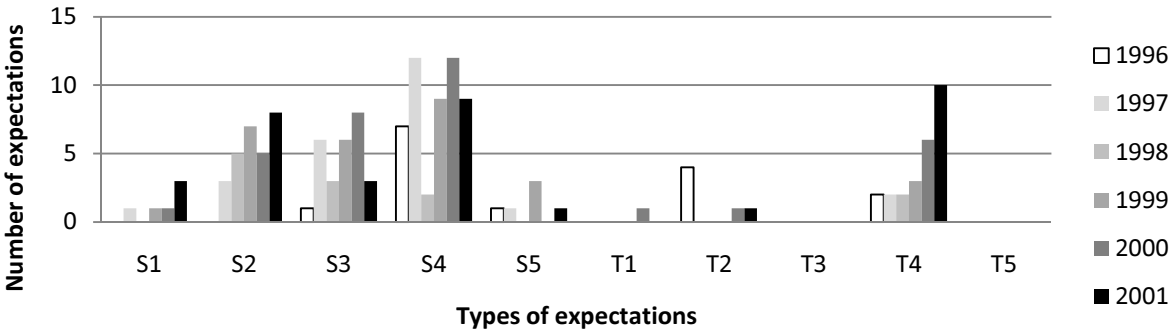

Figure 26: The type and number of respective expectations on mobile telephones (1996-2001).

A place in society (2002-2005)

Previously, discourse around mobile telephony mostly addressed novelty and emphasised the pace with which the mobile phone was being diffused into society; by the time the innovation was well accepted, the discourse shifted to more mundane discussions about its impact not only on society but also on the evolution of daily routines and the change of user behaviour. This discussion is well covered in the *NRC Handelsblad*. As the innovation is domesticated over time, it is evident that the tone shifts from rather formal and business-like towards anecdotal examples of mobile phone users in daily life. Nevertheless, these seemingly anecdotal instances illustrate the shift from predictions and glorified expectations about the use and technological possibilities of mobile phones, to a more mundane character of the use of mobile phones (McGuigan, 2005).

The mobile phone changed many social conditions and interactions throughout time and as a part of its domestication, society seemingly seemed to experiment with etiquette. When the mobile phone was still an item that increased a user's social status, it could easily be boasted with. As the mobile phone became available to a greater portion of the public, this type of behaviour would be quickly ridiculed; the more ordinary that the appearance of mobile phones became, the more ordinary the responses from society. Nonetheless, the mobile phone remained a symbol of status amongst youngsters, just like branded clothing. In terms of etiquette, the mobile phone was a source of aggravation for some, an annoying plethora ring tones, unwantedly listening off to other people's conversations, et cetera; this was undesirable in some public spaces such as theatres and restaurants. Of course, the acceptance of an innovation such as the mobile phone seems to increase with its user base and different social groups may actually have different types of etiquette. It is believed to be perfectly normal for young people to 'multi-task' social interactions, where texting or

even picking up the phone in the midst of a real-life conversation is not frowned upon. Other social groups adhere to different etiquette and would find the aforementioned instance outright rude. This again correlates to the difference in meaning and routines amongst various social groups (NRC, 12-01-2002).

In addition to the routinisation of mobile telephony itself, the first half of the 2000s saw maturation in the use of the Short Message Service (SMS) as well as the introduction of various technological additions. The SMS-hype especially caught on in the younger segment of the population as this service was cheaper and more versatile to use than actually calling other individuals. Within a very short period of time this service also quickly diffused into other social groups (NRC, 18-10-2003), it is likely that the ease of use and clear purpose of texting helped it in quickly establishing itself. In terms of additional technological features, the mid 2000s saw the rise of the mobile phone with built in camera. First introduced in 2002 by Sanyo ([41]), the 'camera-phone', quickly overtook 'normal' mobile phones in terms of unit sales by late 2004 (NRC, 04-12-2004). Consumers were not only comfortable with mobile phones but were prepared to invest in newer models with increased functionality and various gadgets. In fact, the introductions of various smaller features proceeded so quickly, that by 2005 camera-phones had become fairly mundane and were no longer enough to pique the interest of people looking to replace their existing camera-phones. Because of this, mobile phone producers spurred ahead by also integrating radio and mp3 music functions. Despite the quick diffusion and adoption of the SMS and various technological features there were still many users that were not very familiar with these enhancements; as the CEO from one mobile phone provider highlighted: "*more than half of mobile phone users in the Netherlands has never sent an SMS in their life*" (NRC, 17-06-2004). Nevertheless, mobile phone providers were attempting to introduce, and create acceptance for, yet another generation of mobile phones capable of mobile internet via the still-to-be-introduced UMTS network.

In addition to the many difficulties that UMTS faced in the early 2000s because of the need for extremely large investments and very expensive frequency licences; the technology would also create yet another health scare and consequently further delays in its adoption. Whereas the health scare concerning electro-magnetic radiation from mobile phones did not seem to have a profound impact on the diffusion of said technology, the health scare caused by UMTS resulted in many protests. Consequently, after receiving complaints about fatigue and headaches from inhabitants, at least 40 Dutch municipalities refused to continue construction of the UMTS base stations; these municipalities demanded more clarity on possible dangers from the Dutch government (NRC, 30-07-2005; NRC, 27-12-2005), this issue would only be resolved in 2006 after the Public Health Council concluded that there is no apparent danger from the radiation emitted by UMTS base stations. Nonetheless, it would mean that the technology would be further delayed, much to the displeasure of many mobile phone providers (NRC, 10-06-2006).

After mobile phone market saturation in the 2002-2003 period, the increasing pace of 'replacement-iterations' - where mobile phone users replace their old phone - is by no means a real surprise; at this time subscriptions were sold based on a one or two year contract, and in order to convince existing users to replace their current mobile phone, ever more advanced models were offered (NRC, 12-03-

[41] Webdesigner Depot, 2011, The evolution of cell phone design between 1993-2009: *http://www.webdesignerdepot.com/2009/05/the-evolution-of-cell-phone-design-between-1983-2009/*

2005). Furthermore, the increasingly cheaper and versatile mobile phone continued to replace normal land-lines, as one industry representative highlighted: "*In five to ten years from now, I don't think that anyone in the Netherlands will possess an ordinary land line anymore. The subscription fees are almost dropping on a monthly basis. There is a point in time that mobile telephony and standard telephony will be equally priced. And: mobile telephony is more comfortable*" (NRC, 31-12-2004). This positive expectation was certainly not far from the truth because in 2005, 15% of Dutch households were no longer using land lines. In contrast, there were more mobile telephone connections in the Netherlands than inhabitants. From its first commercial introduction to a wider public, it took the mobile phone only ten years to diffuse amongst almost the entire Dutch population (NRC, 17-12-2005;[35]).

Dynamics in the history of the mobile phone (2002-2005)

The period onwards from 2002 is characterised by the mundane character of the mobile telephone in society. Over the years the mobile phone transformed from status item, to fashion item to commodity. Indeed, with more than 15 million connections in the Netherlands from 2004 on, it is no baseless assumption that almost every Dutch citizen possessed a mobile phone. By 2002 however, the Dutch mobile telephone market crashed. This was largely due to the market saturation and not so much due to the many negative health related expectations from the previous years; nevertheless, these negative expectations may have caused some reluctance amongst the public, but this is not clear from the discourse. The subsequent rise in mobile telephone connections is then due to the fact that with the next 'replacement iteration', subscribers could opt to acquire a new mobile phone with their new subscription. Furthermore, by this time, some people even possessed more than mobile telephone for business or private use. In addition, the introduction of new innovations such as the camera-telephone piqued interest from both existing and new users. These technical innovations in mobile phones would help spur the continuous growth of the mobile telephone market in the future. Finally, with society being so comfortable with the innovation, users were willing to invest in these newer models and felt confident about the use of the mobile phone in general (see Figure 27).

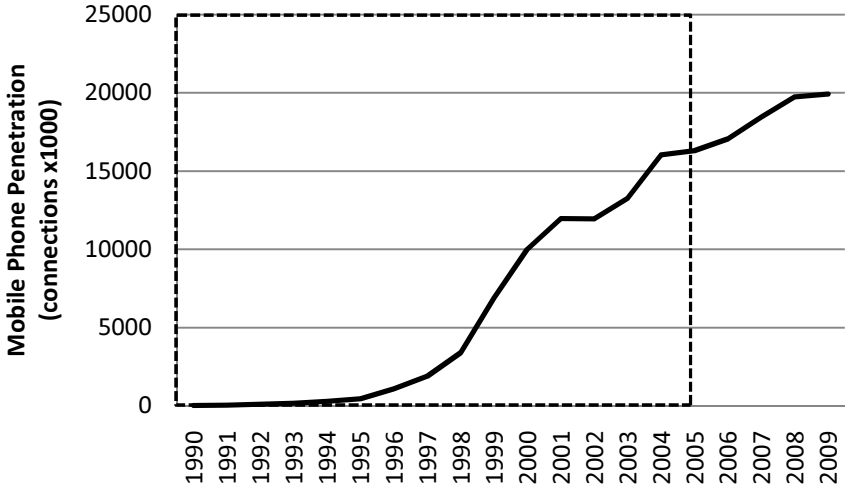

Figure 27: Mobile phone penetration in the Netherlands in thousands of connections (1990-2005)[34],[38],[39],[40].

The crashed mobile telephone market is also very well visible in the number of mobile telephone selling points. At this point the number of new mobile phone selling points has little to do with social

acceptance, and are likely to be a purely economical consideration. Naturally, with the advent of new mobile phone models in 2002 and the renewed interest in newer models from the public, the number of mobile selling points increases again. It is also interesting to note the lag effect between adoption and availability here; after lack of interest from the public because of market saturation, mobile telephone companies respond in kind by not expanding their franchise in the following year. With renewed interest in mobile telephony in 2002-2003 however, we see a subsequent rise in selling points in 2003-2004 again (see Figure 28).

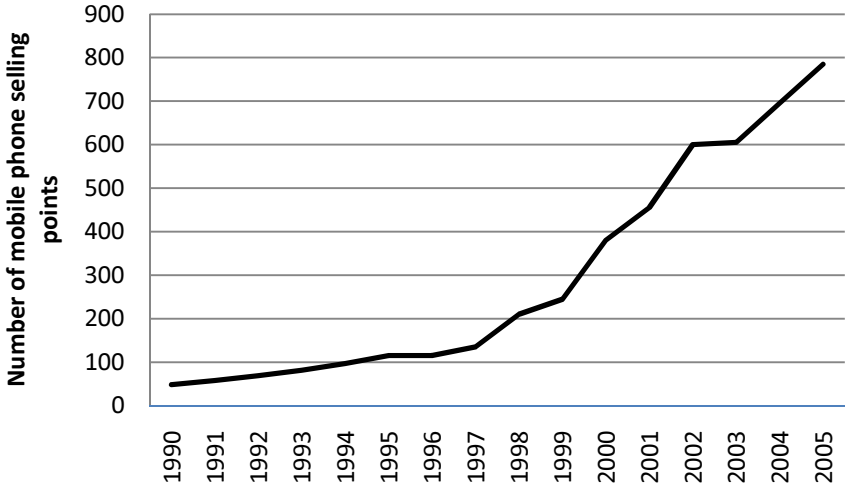

Figure 28: Number of mobile phone selling points in the Netherlands (1990-2005)[35],[36].

Accordingly, visibility seemed to experience a dip as well, as the lack of discourse became casual due to the lack of innovations in the 2001-2002 period. The rise in visibility is likely to be attributable to new innovations. This can be seen in Figure 29. The slight loss in interest also seems synonymous with the domestication of the innovation, by the year 2002 there were 12 million mobile phone connections in the Netherlands. During this time, the mobile telephone had become an ordinary commodity with more mobile telephone connections than inhabitants in the Netherlands from 2004 on. As a result, attention in discourse would naturally wane as no new expectations are generated either.

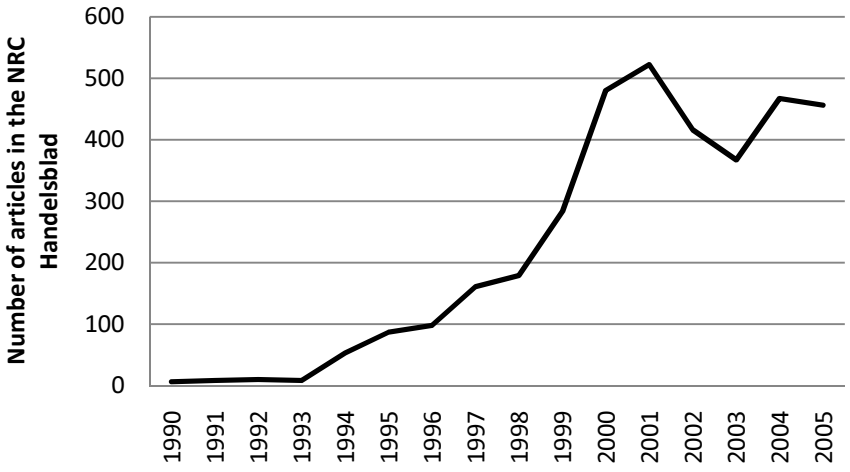

Figure 29: Number of articles in the *NRC Handelsblad* containing a combination of keywords related to "mobile phones" (1990-2005).

In terms of expectations we see a generally rising trend. Expectations in the technological domain consisted mostly of small improvements or the introduction of new features, such as developments in camera-telephone development, music, radio, hearing aids for individuals with hearing impairment, route navigation, television and of course internet. All these developments cumulatively increased the value of the mobile telephone. In the societal domain discussions geared more towards projections about how quickly the 'new' mobile telephone technology would be adopted by society as well as the evolution of existing routines thanks for these innovations. In this respect, the replacement of land lines and telephone booths was a major step towards the integration of the mobile telephone in society. Effectively, the innovation now began replacing old routines as more and more individuals opted for a mobile telephone. Furthermore, the mobile telephone made telephone booths obsolete because the mobile telephone was wherever the user was. To quote a previous *NRC Handelsblad* article: "*For the first time in history we 'don't call telephones but people'"* (NRC, 26-08-1993).

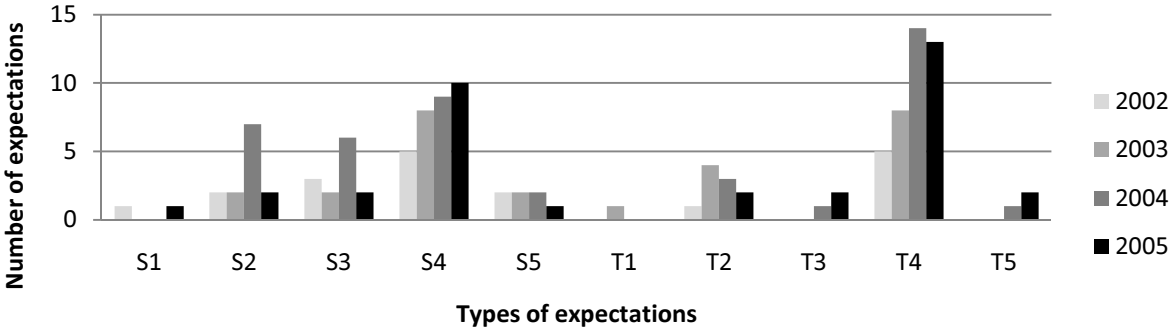

Figure 30: The type and number of respective expectations on mobile telephones (2002-2005).

Synergy with ICT, synergy with society (2006-2009)

As the technology and services matured ever more, the third generation of mobile telephony started seeping through in Dutch society. The third generation allowed mobile phones to access the internet via high speed networks such as UMTS. A specific category of mobile phones, the so-called smart-phones, was designed for comfortable use of the internet. The upgrade to third generation mobile telephony was regarded as an important step by mobile telephony industry to increase revenues again after market saturation in the early 2000s. Especially mobile telephony providers were eager to offer new services to subscribers in the Netherlands and were not just out to satisfy needs but also create new ones: "Mobile operators largely decide what mobile phones are sold in the Netherlands; with this, they aim to satisfy their customer needs - but also try to find ways to earn more money from these same customers" (NRC, 20-03-2006). However, the sale of smart phones was not all that service providers hoped it would be and this is also reflected in the slow growth of the smart phone market throughout the mid to late 2000s; numbers show that 3% of all mobile phones in the Netherlands in 2006 were smart phones, against only 6% in 2008 ([42]). The reason for this is that there was simply no need for mobile internet and advanced features in the Netherlands at this time. One of the biggest reasons for the failure of mobile internet in the Netherlands at this time was attributed to the fact that Japan served as a role model country for the Dutch mobile internet market but

[42] Price Waterhouse Coopers, 2011, Mobile Advertising: *http://www.pwc.com/nl/nl/publicaties/mobile-advertising.jhtml*

because it was fundamentally different the so called i-fashion never took off. Firstly, it was argued that mobile internet was introduced very early in Japan when there were still few mobile telephony users in all. Secondly, Japanese users used their mobile internet mostly to send e-mails, but because SMS texting was so popular in the Netherlands this was unnecessary. Finally, the Dutch population adopted the personal computer more quickly and in relatively greater numbers than the Japanese population which meant, that a mobile internet connection was usually the only way to connect to the internet in Japan. Thus, because the mobile phone possessed a fundamentally different meaning from the start compared to the Netherlands, almost 40% of the Japanese population used mobile internet in 2007 against 1% in the Netherlands during the same year. In comparison, 12% of mobile telephony equipment was internet capable in the Netherlands in 2006 (NRC, 24-08-2007;[43]). Another reason for its failure is the fact that mobile internet was extremely expensive in comparison to "normal" internet, few users were willing to pay up to two Euros per megabyte when they could enjoy flat-rate internet on their personal computer at home (NRC, 05-05-2007).

Throughout the years however, a rise would be seen in mobile internet and the use of smart phones. One notable event that revived competition in the smart phone industry was the introduction of Apple's iPhone which received a fair amount of attention in the *NRC Handelsblad* from 2007 to 2009. The invigoration caused by Apple's smart marketing and novel innovations meant that from the iPhone's introduction all mobile phone producers would focus themselves on the smart phone market. Another aspect that provided smart phones with extra meaning was the use of add-on applications such as navigation, games and various utilities; this in turn created a new market and by 2009 there were over 50.000 applications available for the iPhone alone. Consequently, the acceptance of mobile telephones with access to the internet was growing and although the general sale of mobile phones was in decline world-wide, the sale of smart phones was actually on the rise (NRC, 11-07-2009). This is also reflected in the number of internet capable mobile phones in the Netherlands in 2009, which amounted to 28%, in comparison to 12% in 2006 ([43]).

In addition to the synergy that mobile telephony was reaching with other ICT artefacts, mobile telephones also procured freshly articulated meanings. Most notably, their photo and video functionality seemed to have a large effect on contemporary society. As society discovered this specific functionality and not only began experimenting, but also started domesticating it, a new meaning emerged. This particular part of discourse on mobile telephones started with the replacement of old routines in photography and their implications on the photo-camera industry: "*It was a powerful expression [...]. The young soldiers extended their arm and pointed their mobile phones towards the sky; they tracked the flying helicopters with them. Digital telephone recordings for the home front. Welcome to the 21st century.*" (NRC, 31-01-2006). Soon, the possibilities of mobile telephone recordings were acknowledged throughout society. Some establishments sought to integrate this feature as a form of consumer feedback. The Dutch railway service for example, allowed commuters to send pictures of potentially unsafe or undesirable conditions such as bad lighting or graffiti (NRC, 10-02-2006). But the main potential of this feature was their ability to help solve crimes. Indeed, the Dutch authorities were becoming very interested in this ability in the mid 2000s and several articles from May 2006 reflect this: "*The police will structurally use citizens' camera images from mobile telephones. With both pictures and video recordings of summary*

[43] CBS, 2011, ICT gebruik van personen naar persoonskenmerken:
http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=71098ned&D1=33-133&D2=0-2&D3=a&VW=T

offences, accidents and suspicious activities citizens could provide an important contribution to crime fighting. Citizens will be asked to send such images [to the authorities]." (NRC, 10-05-2006).

This feature however also caused societal concern because of breaches in privacy and values. The most powerful examples are provided within the context of misuse amongst youngsters. The quickly emerging and expanding trend of filming or photographing other people's misfortunes led to an entire culture feeding on schadenfreude: "*The camera has become a weapon amongst students. You organise a beating, record it and the entire school watches it. Just for fun, says a perpetrator. A 'social cancer', says a chief police commissioner.*" (NRC, 18-03-2006). Naturally, the internet allowed this content to be disseminated over an even larger public and with the internet's inherent anonymity made controlling this content virtually impossible (NRC, 28-03-2006). The implication for victims of this digital bullying could be quite profound; consequently, social image or video websites responded to this by allowing this type of content to be reported by users, prompting it to be removed from the website (NRC, 24-11-2009).

Dynamics in the history of the mobile phone (2006-2009)

The final period in the history of the mobile telephone is especially conspicuous due to the penetration of the mobile telephone in the Netherlands. By 2004 already, the mobile telephone had become such a mundane commodity that it was also affordable for individuals to possess more than mobile phone. Indeed, penetration of the mobile telephone rises up to approximately 120% (see Figure 31). These numbers imply that there is one extra SIM-card active for every four people; thus theoretically, one in four people possess a second active mobile telephone in the Netherlands. No doubt, one of the reasons for this is not only separating business and private interactions but is also attributable to the technological development of the mobile telephone. After market saturation of the mobile telephone more and more producers sought to integrate new innovations into their designs and once again renew attractiveness for the mobile telephone. Nevertheless, further diffusion of these technologies is slow in comparison with the introduction of the camera phone in 2002. This is also due to the fact that the market, in contrast with 2002, is now fully saturated and although the cell phone is affordable, individuals see little reason to replace a working machine. As a result of this, the diffusion of the next generation mobile telephone – the 'gadget-phone' or smart-phone – proceeded much slower than before.

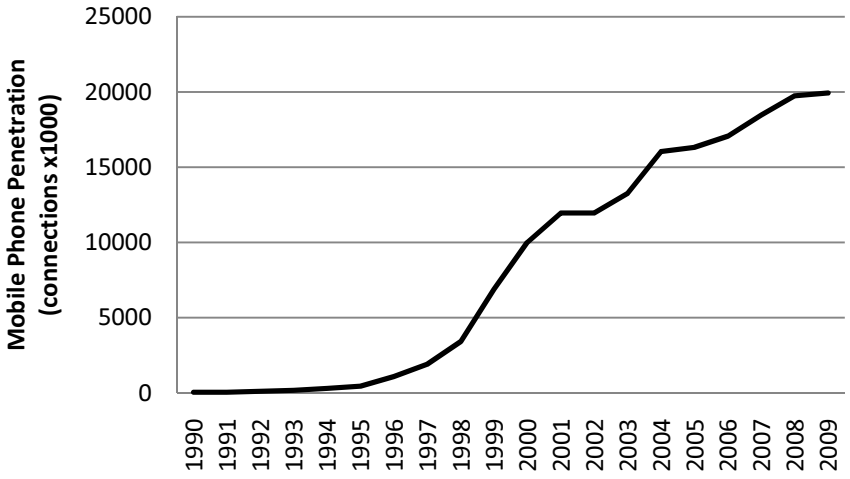

Figure 31: Mobile phone penetration in the Netherlands in thousands of connections (1990-2009)[34, 38, 39, 40].

With the complete market saturation of the mobile telephony market again from 2008 onwards, the growth in mobile telephone selling points stagnated accordingly; this is also visible in Figure 32 below.

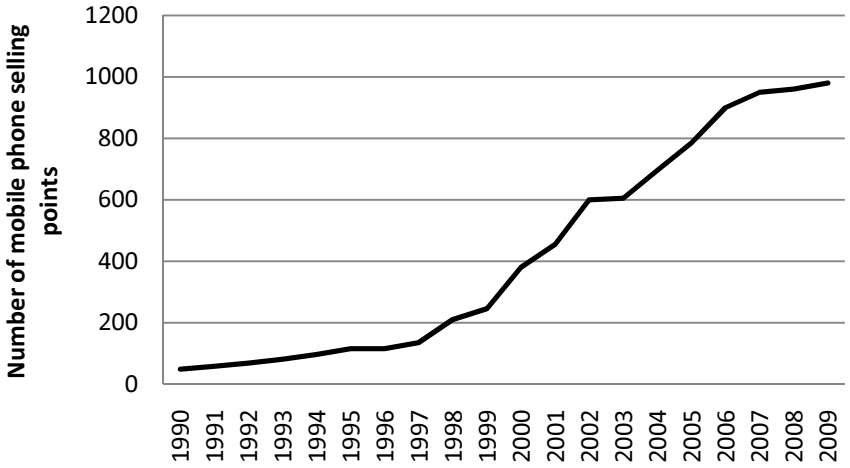

Figure 32: Number of mobile phone selling points in the Netherlands (1990-2009)[35],[36],[44].

After the innovation had become a mundane artefact in society and almost every individual in the Netherlands likely possessed one, the tone of the general discourse also shifted to casual mention of the technology. While newer technological developments and add-on features for mobile telephones generated fresh expectations, they did not seem to create a breakthrough character, or hype as visible as the first peak in visibility during the early 2000s, or a peak as comparable as the one seen with internet technology. By the end of the 2000s both the mobile telephone and the internet were common that they lost their visibility in discourse and even the synergy between mobile phones and internet was considered to be an obvious transition. No doubt, this is also party attributable due to the fact that discussion on bringing together mobile telephony and internet existed for very long. The visibility for the mobile telephone can be seen below in Figure 33.

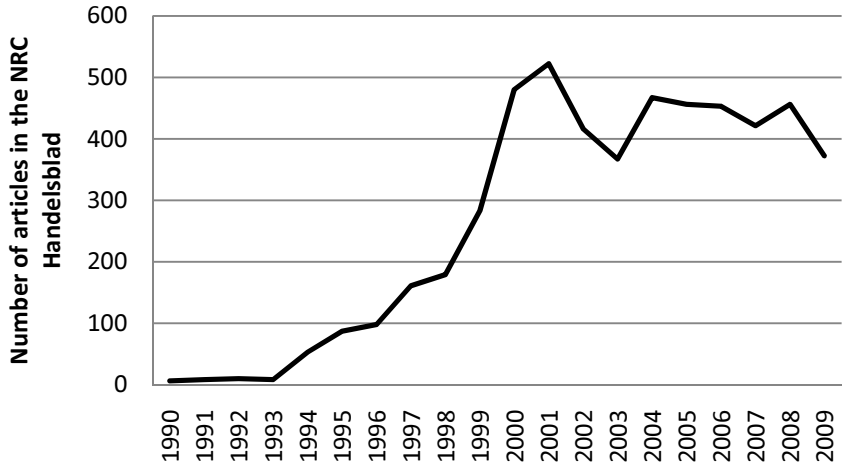

Figure 33: Number of articles in the *NRC Handelsblad* containing a combination of keywords related to "mobile phones" (1990-2009).

[44] National Board for Retail Trade, 2010, Number of mobile phone selling points (2006-2009): *http://www.hbd.nl/pages/15/Winkels/Telecomzaken/Aantal-winkels.html?subonderwerp_id=743*

The mobile telephone was already indispensable for most, if not all of the social groups encountered in the *NRC Handelsblad*. Further technological development increased the cumulative value of the innovation and changed or replaced existing routines (from ordinary telephone to camera phone to smart phone; or land lines to mobile telephones) but did little to change the perceived indispensability of the artefact. Few over-arching expectations still existed during this time, and there were mostly related to the synergy with the internet and mobile telephony as well as the possible growth in diffusion of the smart-phone. However, very few of these expectations contained a true breakthrough element as seen with the inception of technology and its early adoption. Most expectations were thus limited to lower levels. In terms of routinisation, mobile telephones continued to replace existing routines and with the new features present, the number of routines that could be replaced grew. For instance, land lines were slowly losing ground amongst the mobile telephony revolution; the telephone could double as a music player or radio; it could double as photo camera for quick snap-shots and finally, it became advanced enough to even allow comfortable use of the internet. In terms of specific products, we see that Apple's iPhone generated a fair amount of attention and consequently, expectations. These expectations naturally mobilised the mobile telephone industry to develop their own successful smart-phones based on innovations first seen with the iPhone. Raised expectations by Apple turned the iPhone in a company success and the iPhone effectively received more attention in media than other smart-phones during this time. Thus, we see how expectations not only influence technological development or societal embedding but how technology also creates new expectations.

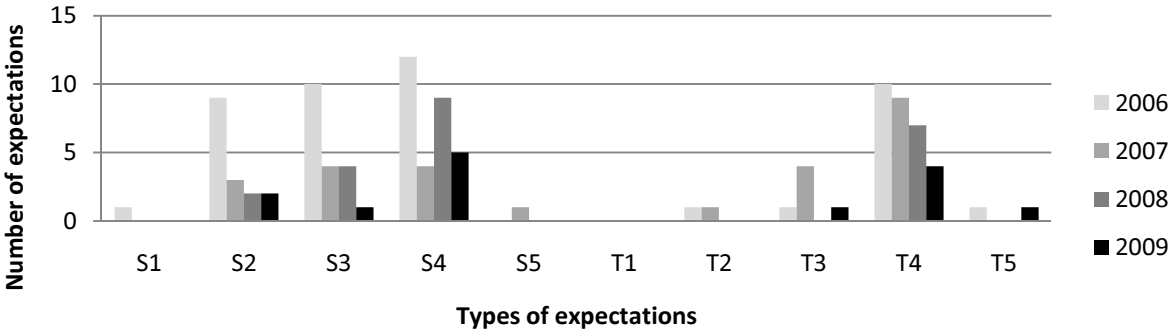

Figure 34: The type and number of respective expectations on mobile telephones (2006-2009).

Case III: Personal Computers

The herald of the digital age, pre-1990

'Few realise that [this 'modern calculator' will become] the greatest of inventions since the steam engine, and will herald a new era for the world' ([45]). Considering the Dutch sociologist Fred Polak spoke about this in 1949, the quote was very well ahead of its time; in the way that what we now know as personal computers, has become common property in society and has reshaped it. Naturally, it would take some time before we would witness the computer in its current form, and this would require reaching several milestones. One such milestone, and arguably the first one, is the invention of the integrated circuit or microchip by Jack Kilby in 1958. Just a couple of years later, Kilby built the first computer at Texas Instruments using his integrated circuits ([46]). At this time however, microchips were used in so-called desktop electronic calculators rather than computers. Here, an important technological breakthrough in order to facilitate the transition to actual computers was the microprocessor, which appeared in the early 1970s and allowed the computer to perform a variety of tasks ([47]).

For personal computers, the integrated circuits and microchips were previously available as part of a 'kit', however during the mid 1970s the transition from 'kit' to complete computer would take place. The resulting computer eventually found its way into society and was domesticated across several segments while appearing in different varieties. Firstly, office computers functioned as spreadsheet, database and word processors and were generally considered to be rather expensive devices. Secondly, desktop computers performed the same functions as office computers but were aimed at cheaper market segments for academics, small businesses and professionals. Finally, so-called home computers were available for the wider public. Here, the most famous example is probably Sinclair's ZX80 ([48]).

The true revolution of the personal computer takes place in the 1980s however, when IBM steps into the personal computer market and turns the name into a brand. The first IBM personal computers were available in the Netherlands from the early 1980s and the machine set new standards for both ease and quality ([47]). In addition, the arrival of IBM's personal computer creates an entirely new market segment. Whereas the first 'personal computers' were still largely programmable devices, the arrival of software packages and IBM's PC caused a shift in the type of use. Consequently, the personal computer found its way into general society and the majority of these users were of the non-programming kind. As a result, the acceptance of the personal computer grew throughout and IBM's PC became a dominant system in the mid and late 1980s. Indeed, figures show that 90% of the market was dominated by the IBM PC and her clones in combination with Microsoft's MS-DOS operating system ([48]). Thus, by the beginning of the 1990s the personal computer was already a very familiar sight.

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[45] Foundation for Computer Heritage Netherlands (SCEN), 2009, Fred Polak (1949) in: Historische computers: erfgoed van de digitale evolutie, p. 20: *http://www.computer-erfgoed.nl/PDF%27s/NRHC_Rapport_1e_fase_augustus_2010_bijl_1.pdf*

[46] IEEE Global History Network, 10 September 2008, Jack Kilby: Biography: *http://www.ieeeghn.org/wiki/index.php/Jack_Kilby*

[47] The Eighties Club, 2000, Jason Manning, The Computer Revolution: *http://eightiesclub.tripod.com/id325.htm*

Indispensability, war and peace (1990-1993)

Of the three cases the personal computer was the most familiar and well established technology in 1990. Indeed, when the majority of people were yet to hear about the internet or see a mobile telephone in real life, the personal computer was already regarded as an indispensable workhorse: "*Ten years ago practically no-one possessed a personal computer; however, this apparatus has become an integral part of companies, offices and work spaces at home.*" (NRC, 23-06-1990). The personal computer had thus diffused quite well throughout business and was a seemingly important tool. In this respect, the personal computer was also responsible for a shift in routines as tele-working or telecommuting became an interesting option, which allowed commuters to work at home (NRC, 08-05-1991).

The majority of the discourse however was geared towards fierce competition between various companies that tried to get the upper hand on the personal computer market. Amongst producers of personal computers there is mention of Compaq, Philips, Tandy, Apple, Siemens, Sony, Tulip and Hewlett Packard (NRC, 1990-1993). The manufacturers introduced the so-called personal computer clones after IBM successfully established their personal computer as the dominant design on the PC market. During this period the vast majority of the computer market was dominated by IBM PCs or related clones, equipped with Intel processors and the MS-DOS operating system. However, the market underwent further transformation and because of the inherent nature of the personal computer - a device of architectural nature that is built up of various standard components such as a monitor, processor, memory bank et cetera - the personal computer became an ordinary commodity. The nature of the personal computer meant that computer shop franchises, not manufacturers, became the largest computer vendors; customers could compose their own tailored personal computer based on standard parts that the vendor would offer and were equipped with standard features such as an operating system and mouse ([48]).

Although the personal computer successfully diffused into business, the innovation's meaning in the educational segment was not yet fully understood. While the majority of school possessed at least one personal computer, this was rarely used as it did not add substantially to the curriculum. From a socially oriented perspective, teachers were also afraid that the personal computer might try to replace their position and were hesitant to introduce this technology into their classroom. Furthermore, the teachers themselves lacked a level of computer literacy which naturally made it difficult to disseminate further purpose. Another reason for the poor track record in computer use in schools was due to the fact that these computers mostly lacked well designed and standardised software for educational purposes. The Dutch government however, stimulated diffusion of the personal computer in education by offering 'private-PC-projects' and supported its respective software through the use of software-coupons. While the Dutch government undertook these actions, it quickly reached the conclusion that this was a difficult endeavour and wanted to leave it to the market to find tailored solutions. The problem however, was that there was no market present for educational software. Furthermore, the quick development of technology meant that by the time schools possessed personal computers, their PC types were already considered to be obsolete. Thus, while Dutch government was instrumental in stimulating the procurement of personal computers for

[48] On behalf of the appraisal commission National Register Historical Computers by dr. Gerard Alberts and dr. Willem Melching, Foundation for Computer Heritage Netherlands (SCEN): *2011, http://www.computer-erfgoed.nl/computergeschiedenis_volg_3.htm*

educational use, it failed in implementing these measures in the current education system and left educational institutions muddling through by themselves (NRC, 29-10-1992; NRC, 16-12-1993).

The communication vehicle of the future and the domesticated pet (1994-2001)
Despite the seemingly negative discourse on personal computers and their role in education in the previous years, the introduction of the internet in the Netherlands prompted new discussions in relationship to the personal computer. From the mid to late 1990s the personal computer slowly acquires its meaning as a vehicle for future communications. With the commercial introduction of the internet in the Netherlands in 1993, the personal computer's value in this role is naturally quickly understood. This of course generates a large number of very positive expectations during these years. It is interesting to note that some of the most positive expectations are generated by software companies – specifically, Microsoft. Microsoft was instrumental in generating interest in their new Windows 95 operating system that was tailored for multimedia use. This provided the personal computer with new possibilities and purposes, consequently giving new meaning to the personal computer in a large segment of society: "*[Society] will be able to request medical information and news on their computer screens. [The people will be able to] follow courses, play games and watch movies. Whether the 'average' consumer is actually capable of performing these complex computer tasks is still to be seen. [...] Bill Gates says that: 'The system will guide its users; this is going to be easier to use than a VCR'*." (NRC, 15-03-1994). Indeed, the computer industry argued that with the introduction of the internet modem, the personal computer would become the communication vehicle of the future. Consequently, it was expected that by the late 1990s there would easily be a hundred million units sold world-wide (NRC, 02-07-1994; NRC, 09-07-1994). In contrast, the personal computer at this time mostly fulfilled a role as a word-processor, spreadsheet-processor or glorified calculator. With the introduction of the multi-media age however, it would quickly transform into a *'creator, sender and receiver of text, video and audio'* (NRC, 03-06-2000).

But, this was just the tip of the iceberg in terms of expectations; with the introduction of easier to understand operating systems and software, the personal computer became widely accessible to society. This is perhaps best illustrated by the turn that general discourse took after the introduction of Windows 95 by Microsoft. Previously, the personal computer was regarded as a difficult to use artefact and was not very attractive in its use and handling. With the introduction of the graphical interface however, it became easy to use and quickly established its position in society (NRC, 13-07-1995; NRC, 17-01-1997). By 1996 the personal computer was impossible to ignore at work and in households; in this regard, an interesting mention shows how the personal computer became personalised: "*...thus, so the personal computer evolves as a secularised altar that is adorned with lots of different paraphernalia. Monitors are plastered with family pictures, idols, memos, et cetera.*" (NRC, 05-09-1996). The subsequent drop in personal computer prices further surged expectations and stimulated diffusion of the personal computer in the Netherlands as the PC now became not only accessible in terms of literacy but also economically. Visions of the future sketched an image where the computer user would be able to buy and do everything from the comfort of his home. In response to the decrease is price, research showed that over a million of Dutch households were planning to purchase a personal computer before the end of 1998. By this time, the personal computer had already acquired indispensable characteristics amongst students (NRC, 17-01-1997; NRC, 02-08-1997; NRC, 16-10-1998).

From a different societal perspective however, the personal computer also raised concern over a double edged digital divide. Firstly, the personal computer was an expensive artefact in comparison to for example a mobile phone. Whereas mobile phones were provided without charge when subscribing to a mobile telephony provider, a mid segment personal computer could easily cost up to €800; in high-end segments this could easily be well over €1500. Naturally, this was out of reach for the poorer segments of society, limiting their ability to experiment with these innovations. Furthermore, the personal computer was often regarded as a complex artefact which meant that computer literacy was an important skill in order to use the PC efficiently. The innovation therefore seemed to be geared towards young and higher educated segment of society. Because the personal computer and the internet were slowly intertwining this perception was not very surprising as the same social group that used personal computer on a casual basis, also used the internet in the same way. Interesting enough, the discussions on the digital divide are provided in retrospect rather than in terms of actuality (NRC, 23-06-1994; NRC, 28-02-2002; NRC, 20-30-2007).

The window to the world, but not the only one (2002-2009)

With the widespread diffusion of the internet in the Netherlands in the early 2000s, the personal computer was increasingly regarded as a gateway to the world rather than a multi-media platform. This is also somewhat evident from the introduction of peripherals such as the webcam and microphone, which extended personal computer possibilities and transformed it into an intermediary between human communications or 'video-phone' instead of an inanimate object (New York Times, 04-09-2003). The introduction of online video communities enhanced this function even further as users could now share their multi-media content with vast groups of people around the world (Shida & Gater, 2007). The personal computer and the internet were flowing together and the boundaries between the two started disappearing as arguably, one innovation required the other (12-10-2005).

By 2004 four in five households, or 82% or persons has access to a personal computer. The reason for the innovation's quick diffusion in the Netherlands at least was amongst other factors, largely contributable to the Dutch government's initiative of the so-called private-PC project. This project allowed households that purchased their personal computer via work, to make their personal computer fiscally deductible. With the vast majority of the Dutch population having access to PCs, the arrangement was discontinued (NRC, 31-08-2004). Interesting enough, the number of personal computer users without access to the internet shrunk to 9%, whereas this was still almost 40% in 1998 ([43]). At the same time, the accessibility and value of the innovation increased with prices shrinking by a factor of ten and performance increasing by a much larger order of magnitude. Nonetheless, 25 years after the first PC was sold, the height of its success was coming to a slow end by the end of the 2000s. This was due to the technological developments in mobile technologies such as smart phones, which allowed comfortable access and use of the internet. The PC was a more comfortable platform but lost some of its monopoly as an interface apparatus for the internet; it could now be rather easily replaced by new technologies (NRC, 12-08-2006). It is no coincidence however, that computer chip producers hailed these new markets with enthusiasm. With the PC market being completely saturated with desktop computers, businesses were attempting to find new sources of revenue (NRC 24-12-2009). Despite the fact that the personal computer had lost some of its glory however, it remained a mainstay in society and was impossible to ignore.

Dynamics in the history of the Personal Computer (1990-2009)

During the early 1990s the personal computer had acquired some meaning in business and industry. The personal computer remained a relatively complex artefact throughout this period however due to the lack of a graphical user interface (GUI), and was therefore slow in its adoption amongst a larger public. In businesses the personal computer quickly gained a status as a workhorse however and allowed to process existing tasks more efficiently and effectively. The Dutch government quickly recognised the importance of the personal computer and stimulated its diffusion into educational institutions. These measures existed of projects which made procurement of hardware and software more attractive. However, during this early period the Dutch government failed to give shape to a clear use for the use of personal computers in schools. As a result, the lack of meaning made schools reluctant to add the innovation to the existing curriculum and the personal computer found itself stored away in dusty corners. Nonetheless, the stimuli provided by the government to make the personal computer not only accessible in schools but also in a larger segment of society meant that the innovations diffusion steadily grew, which can also be seen in Figure 35 below.

Because the personal computer was both expensive and inherently complex at least until the arrival of the GUI-based operating systems and software its adoption increased rather steadily than dramatically. After the introduction of GUI software however, a small rise in the rate of adoption can be seen; it is likely however that the internet plays a role here as well, as the personal computer is of course at this time still the only interface to the World Wide Web. This is also the reason that after equalisation of both the number of persons with access to the internet and the number of persons with access to a personal computer the respective rates of adoption of these innovations almost go hand in hand. This is especially evident with the rise of cheap flat-rate internet in the Netherlands from 2002-2004.

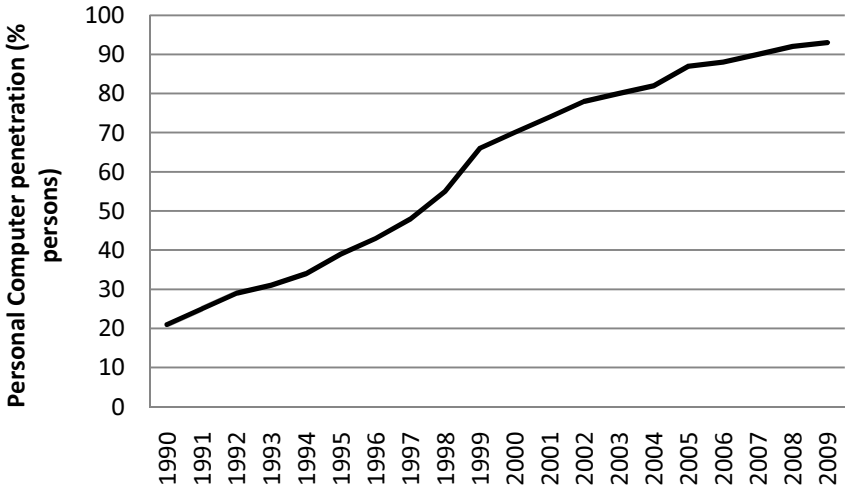

Figure 35: Personal computer penetration in the Netherlands in % persons (1990-2009)[49],[50],[51].

[49] CBS Statline, PC use 1990-1998: *http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=37662&D1=34&D2=71-82&HDR=T&STB=G1&VW=T*

[50] CBS Statline, PC use 1999-2004: *http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=70655ned&D1=11-16,53-71,146&D2=0-2&D3=a&VW=T*

[51] CBS Statline, PC use 2005-2009: *http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=71098ned&D1=0-32,55,60&D2=0-2&D3=a&VW=T*

Although there was some social concern that the personal computer (and internet – these concepts are rather difficult to keep apart from 1995 on) could create a social divide the governments stimuli partly resolved this. Furthermore, because of constant technical advances and the opening market of the innovation prices dropped dramatically while at the same performance of the personal computer increased on equal terms (see Figure 36). Computer models were already obsolete by the time they left their packaging and the replacement iterations by users up until the early 2000s, took place once three years or less (NRC, 12-08-2006). Despite the dramatic drop in prices however, the personal computer remained an expensive artefact arguably making it somewhat slower to diffuse.

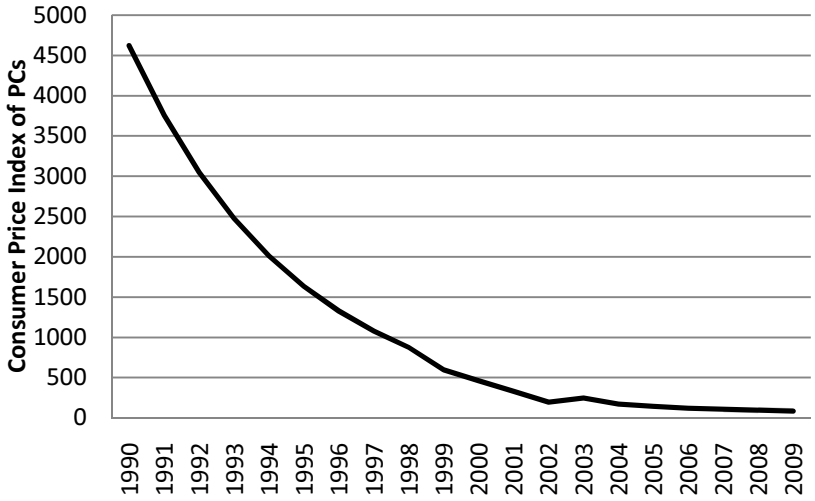

Figure 36: Consumer price index of personal computers (1990-2009)[52].

The divide in terms of literacy was most profound during the early years before the inception of Microsoft's Windows 95 mass market GUI-based operating system. Furthermore, one must also remember Rogers' (2003) statement that 'computer software is indispensable to computer hardware'; its implications are rather intricate in the sense that, it is actually the computer software that pushes forward acceptance of the personal computer. After all, a computer without software is nothing and does nothing (NRC, 10-09-1999). As the innovation is easier to use, it becomes more interesting for potentially new users to trial the PC. After the sleek GUI convinced users that the innovation is indeed not an object that requires extensive knowledge about all sort of commands but can be used by anyone it created acceptance amongst these users. In this sense it also seems that the true meaning of personal computers is not so much provided by the innovation itself, but rather by the possibilities that its software provide. In this sense, ever evolving computer software also gave rise to new and evolving routines. Because software tailored to perform certain functions could efficiently replace existing routines and more efficient software in turn replaced old routines.

Microsoft's role should not be underestimated in creating not only a mass market for the consumer and effectively turning the personal computer into a commodity instead of luxury, but also in creating acceptance for the personal computer amongst users. In sum, as the personal computer became cheaper however, the economically social divide was slowly closed. As the innovation

[52] U.S. Bureau for Labor Statistics, Data extracted on: November 26, 2010 (8:38:13 PM), Consumer Price Index - All Urban Consumers: *http://data.bls.gov/PDQ/servlet/SurveyOutputServlet*

became more accessible and also matured in terms of user friendly software and interfaces, it allowed different users to experiment with it, effectively drawing the literacy divide to a close.

In terms of visibility there is a steady rise with the emergence of the internet but visibility strictly related to the personal computer is rather low. The spikes in attention are firstly due to the internet related hype, and secondly from 2004 on due to the development of new technologies and peripheral equipment for the personal computer. Nonetheless, most are still in some way related to the internet. In comparison, in both 2008 and 2009, out of respectively 153 and 128 articles, 61 and 53 of those were related to the internet in one way or another. The remainder of these articles consisted of rather impersonal statements and contained either casual or anecdotal mention of the innovation. This 'loss' of visibility seems synonymous with the innovation becoming completely absorbed in society, so much even that it is actually no longer 'visible' in discourse. The visibility statistics are shown below in Figure 37.

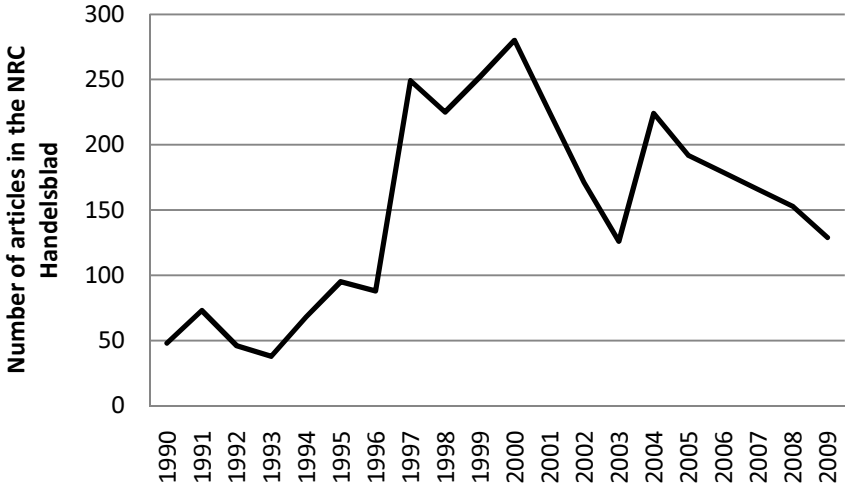

Figure 37: Number of articles in the *NRC Handelsblad* containing the keyword "PC" or "personal computer" (1990-2009).

With regards to expectations, the discourse on personal computers is fairly calm in the early years. There are some positive expectations here and there about the possibilities that personal computers provide in society, as well as some negative aspects of the personal computer. The negative expectations in relation to the lack of government support for the integration of PCs in education is clearly visible however and there is a slight increase in negative expectations emerging from this part of discourse in 1993. Nevertheless, none of the expectations that were indexed show any true breakthrough character. This implies that the innovation is considered to be fairly casual in the social groups that is has diffused into.

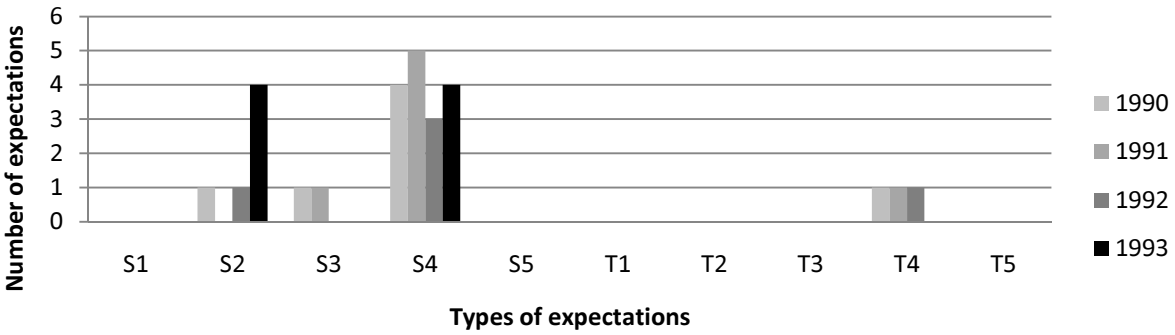

Figure 38: The type and number of respective expectations on the personal computer (1990-1993).

From 1994 however, there is clearly a vast rise in breakthrough type expectations. Two mechanisms are at work here; firstly, Microsoft announces its new and uPComing operating system and is able to generate hype for it which leads to these positive expectations. Secondly, the introduction of the internet in the Netherlands from 1993 on opens up new possibilities for the personal computer, creating new meaning for it and in turn stimulating the creation of new routines as well as increasing the innovation's value. With the growth of the internet as well as the introduction of the aforementioned operating system, expectations remain fairly high throughout the years. However, the casual character of the innovation in society can clearly be seen. Outside of the internet or Microsoft's windows very few truly over-arching discussions exist and most are geared towards lower level expectations. The ever increasing spurs some technological expectations as well, but the 'static nature' of the innovation itself means that there are few breakthroughs. This static nature is related to the fact that the innovation does not truly evolve over time; a personal computer from the early 1990s is not very different from one in the late 2000s, save for the difference in performance and some peripherals such as the transition from CD-ROMs to DVDs. Furthermore, it is software that adds value to the personal computer rather than the components inside the personal computer themselves. Finally, most of the personal computer's technological expectations are already present within the possibilities of the internet and the personal computer in turn aims to facilitate these, thus, strictly speaking there are not many technological or societal expectations tied to the artefact itself. The expectations for the aforementioned period can be seen in Figure 39.

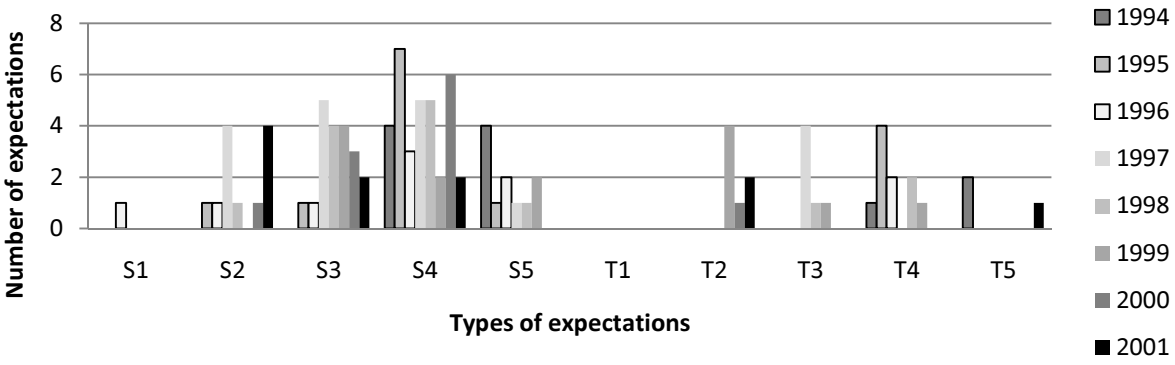

Figure 39: The type and number of respective expectations on the personal computer (1994-2001).

As the personal computer loses some of its visibility in discourse after the early 2000s again, so does the number of expectations slowly diminish. By this time there is congruence between the social groups that have embraced the internet as well as the personal computer because these two

technologies are of course inseparable. This results in a very casual attitude towards the personal computer again. Nonetheless, the introduction of internet telephony (Voice over IP or VoIP) or rather 'making phone calls with the personal computer', in Dutch, provides the personal computer with some fresh attention and generates some technological expectations. Naturally, it is arguable how well these can be attributed solely to the personal computer itself, as VoIP inherently uses the internet and the PC only facilitates this option.

Finally, as the personal computer loses some of its monopoly as sole gateway to the internet with the introduction of smart phones and tablet PCs, the personal computer also loses a portion of its visibility which is reflected in the few new expectations that are generated. In addition, the expectations are now mostly low level and possess no breakthrough elements whatsoever; the innovation is now unconditionally absorbed in society. The expectations for the final period can be seen in Figure 40.

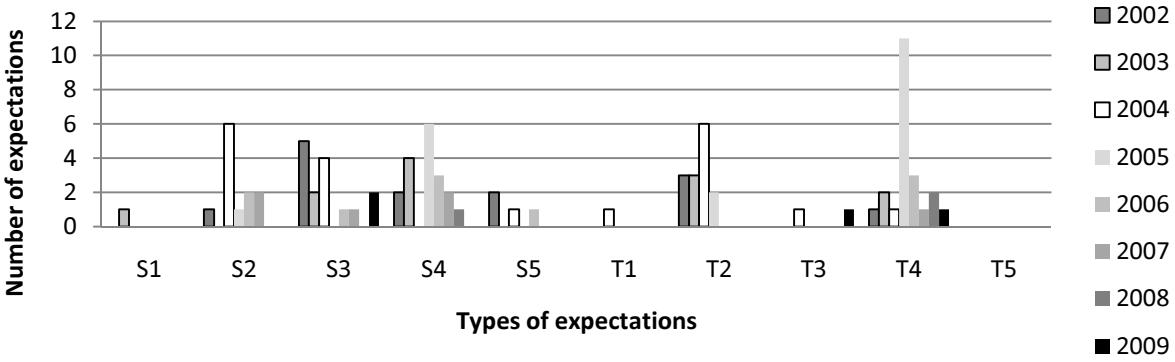

Figure 40: The type and number of respective expectations on the personal computer (2002-2009).

5. Comparison and Discussion

After having presented the individual results for each technology and having kept them as much as separated, I move on to discuss the comparison between the internet, mobile telephones and the personal computer. This section of the report aims at comparing both quantitative and qualitative elements of each technological artefact. This comparison will allow for additional depth in answering the "how" and "when" of indispensability.

The elements that form the basis of this comparison between artefacts are: firstly, timing; or the difference in "when" a technological artefact reaches a state of perceived indispensability as well as the differences or similarities that occur during this process; secondly, the differences or similarities that occur across social groups for each of the technological artefacts; lastly, the differences or similarities in expectations and the evolution of routines over time and their impact on indispensability or vice versa. This allows me to compare points in time "when", and patterns of expectations and routinisation "how" users start attributing quality between each specific artefact.

5.1 Timing, social groups and meaning

As previously mentioned, timing will allow the comparison of a number of distinctions between technological artefacts as these become indispensable. Firstly, it will allow us to compare "when" different artefacts reach a state of perceived indispensability in context of the quantitative elements that have been used for this research. In addition, these artefacts will also be compared in respect to each other.

During this research a number of social groups or societal domains emerged from the reconstruction of the larger narrative. These groups or domains consisted of: businesses in the broad sense; young professionals, youngsters or students, middle aged citizens (between approximately 40-60 years of age) and senior citizens (approximately 60 years and up). Furthermore, an additional 'general' category was identified when discourse described the importance of technology and perceived indispensability in society as a whole. In addition, results revealed that indispensability occurred at different times in different social groups this carries the implication that indispensability is not a universal phenomenon across society.

Finally, results showed that meanings that are imparted on the artefact or the purposes that social groups perceive form an integral part of the concept of indispensability. Thus, in order to provide a vantage point for the comparison we have to look at the meanings/ uses imparted by these social groups upon the artefact. These are placed in context with emerging indispensability across social groups and can be seen in Figure 41 below. Furthermore, the narrative also revealed some major technological milestones and these are added as well because of their breakthrough impact.

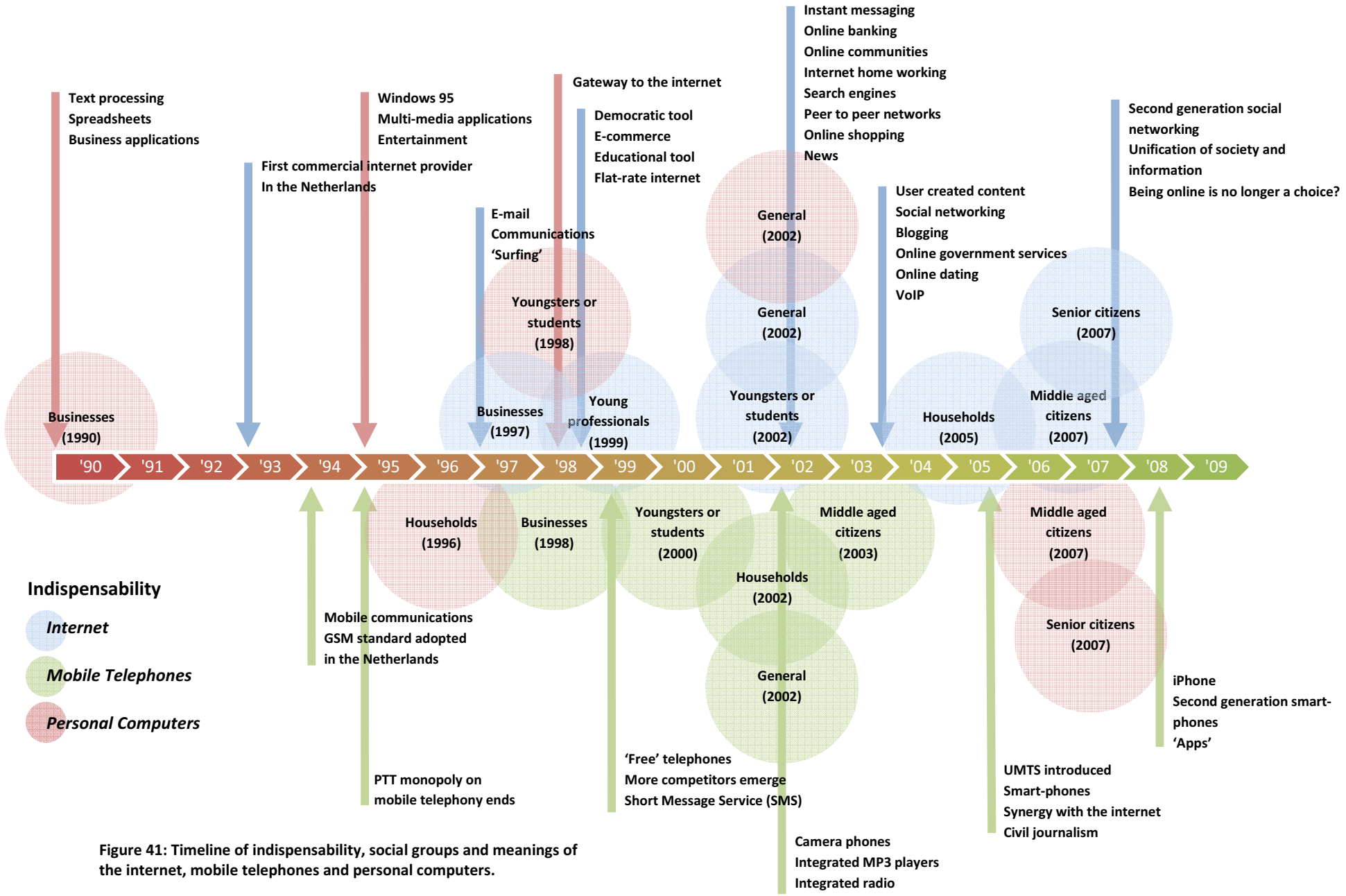

Figure 41: Timeline of indispensability, social groups and meanings of the internet, mobile telephones and personal computers.

The internet

Starting with the internet (see both Figure 41 and Figure 42 for reference), we see first of all that it took almost ten years for the technology to become indispensable across the various social groups. It is also obvious that a lot of time was required before the appearance of the first general meanings. Nevertheless, the earliest evidence of indispensability of the internet is related to the vast use of e-mail and communications in businesses. When businesses discovered the use of e-mail as a form of communications they quickly adopted it and routinised it. Evidence shows that from this moment, loss of the internet could cause major disruptions for businesses as they are unable to communicate internally or externally. Furthermore, the early adoption and subsequent indispensability is likely attributable to the fact that many businesses were very interested in the internet from a very early stage. The narrative highlighted how businesses were jumping on the internet band-wagon wherever and whenever they could. Naturally, this propelled visibility even further as hype was slowly starting to build.

Young professional on the other hand took a profound interest in the internet because of its possibilities in electronic commerce, and together with businesses, generated a true attention peak or hype. As a result, many internet based companies were formed during this time. Naturally, these 'internet-businesses' were dependant on the internet in one way or another, which resulted in a sense of indispensability. Availability of internet content at this time was still fairly sparse however, especially in terms of Dutch content which inevitably resulted in an offset between values and beliefs both online and offline and slowed down the spread into other social groups. Furthermore, the discussion on questionable content found on the internet was still at its height and very well visible within society. No doubt however, that the increased visibility of the internet in society as a whole also generated interest amongst early adopters and spurred the diffusion of the innovation.

The next social group to domesticate the internet consisted of youngsters and students. Especially with the introduction of flat-rate internet, the internet was very affordable. In addition, the personal computer was already in widespread use with approximately 70-80% of Dutch people having access to one. This meant that expensive investments were not especially necessary anymore as most households already possessed a computer. Naturally, youngsters are not very capital capable on their own, but being part of common households, the financial aspect was less of a problem for them. In terms of indispensability, social capital played a major role for youngsters and students. Educational purposes aside, the upkeep of social capital and the creating of new social capital was one of the most important drivers for youngsters to stay connected to the internet. Indeed, it would not be long before the internet was indispensable to them. What first started as contact through e-mail and MSN evolved together with the evolution of the internet. From 2006 on social networking took prevalence in the indispensability regarding social capital of youngsters.

Furthermore, youngsters took a keen interest in so-called peer to peer networks as these allowed them to freely share movies and music amongst another. In addition, online communities formed an early basis for younger internet users around the early 2000s. These online communities allowed 'nerdy' youngsters to partake in online gaming and this stimulated the creation of a social capital system in the form of gaming teams or 'clans'. As the acceptance within the social group itself grew a lateral spread of the artefact could be witnessed, first towards the less 'nerdy' and proficient young 'netizens' and finally into both older and younger age categories within the same social group. It is

likely that the complexity of the internet and the lack of general meaning hampered initial diffusion into this social group, but as the members generated or discovered additional meanings the internet became indispensable for them.

By this time, the *NRC Handelsblad* also mentions the general perceived indispensability of technologies in society for the first time. The article in question, titled "*The rise of ICT is irreversible*" (NRC, 28-02-2002), highlights several positive and negative anecdotal references to the use and integration of ICT technology in society. ICT is regarded as a mixed blessing and is responsible for negative effects, such as the loss of jobs, the inescapable connectivity and required investments; however, it becomes evident that the process is irreversible and the general undertone hints at a rather tragically inevitable process. Nevertheless, the general trend shifts from 'access to the internet' to 'use of the internet'. This is especially evident as the technology is further domesticated by society. Indeed, during the mid 2000s the internet, as a technological artefact, is regarded to be one of the most important 'appliances' in ordinary life and the technology takes on mundane properties.

Between 2002 and 2005, the number of users further increased to over 80%; without doubt, the majority of society was under the impression that 'everybody was using it'. More importantly than the use itself perhaps, was also the urge of individuals to create their own online content. Users had become so used to the concept of the internet, that they not only used it, but also expanded the artefact by offering their own content to the world. Consequently, the number of registered internet domains quickly increased to approximately 1.7 million or about one registered domain per ten persons in the Netherlands. In relationship to this perceived sense of indispensability in society, this meant that values and beliefs both online and offline moved towards each other and society as a whole accepted the innovation. It is also the combination of acceptance and the many meanings that the technology had acquired over time that made it indispensable in households. However, these meanings go beyond the simple explicit ones such as news, search engines, online banking, et cetera. Carrying additional weight, is also the nature of information that could be requested by households. Everything from mundane everyday items on cooking, public transit time tables, or hobby related articles to online government services such as tax forms, insurances and other miscellaneous information.

Middle aged citizens appeared to be one of the last social groups to embrace the internet. Before it became indispensable to this social group, the internet had already fully matured in almost all of its meanings and purposes. However, the internet remained a fairly complex artefact in the eyes of older segments of society. Therefore, meanings alone cannot seem to explain the late adoption by this group. Instead, a logical contribution can be found in the evolution of the services, content and applications themselves. As the internet evolved over time, the standards for user friendliness naturally improved. Together with the vast amount of Dutch content that was offered during this time, this lowered the threshold for this social group to experiment and ultimately domesticate the artefact. On the contrary to the social group of the middle aged citizens, the senior citizens seemed to have the technology being slowly forced upon them. It is arguable whether the technology *truly* became indispensable to senior citizens; judging by the narrative however, this would not so much be by choice but rather by obligation as society moves ever forward to unify itself with information.

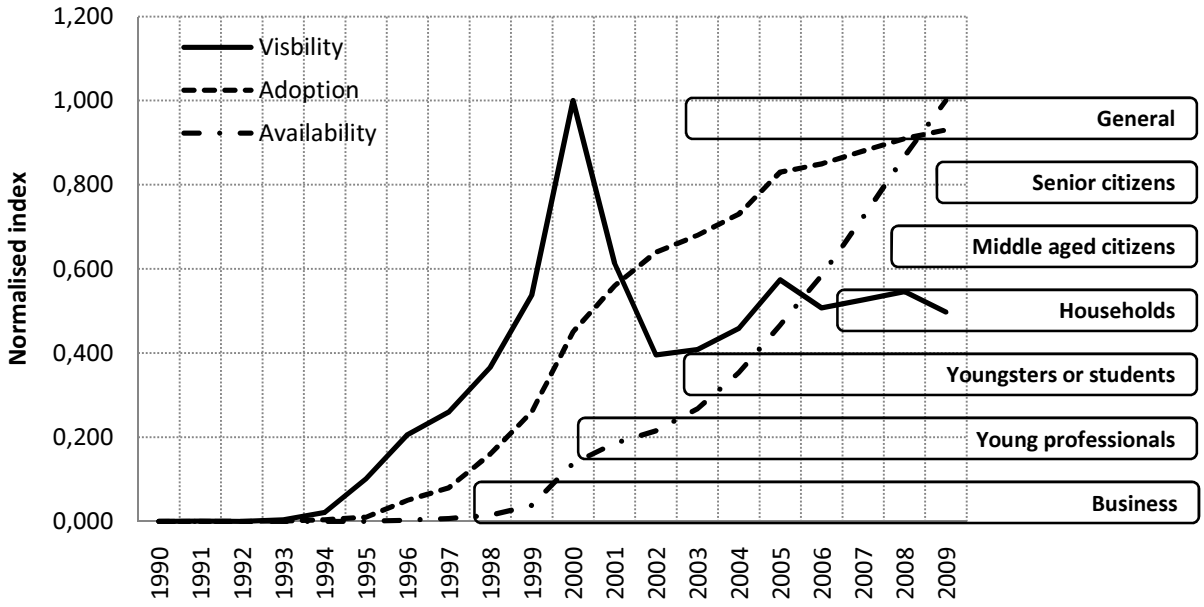

Figure 42: Indispensability amongst various social groups, visibility, adoption and availability of the internet (1990-2009).

Mobile telephones

The mobile telephone possessed a clear meaning from its inception. The only difference between the existing telephone and the mobile telephone was an expansion of the concept of communications, namely mobile communication. From a social point of view however, the mobile telephone personalised telephony. Instead of calling a telephone or location, users could now call other users.

Thus, how does indispensability look across the different social groups? The first thing that is readily noticeable is the rate with which the innovation became indispensability in society as a whole. One of the causes for this is that, in contrast with other technologies, the mobile telephone already possessed a characteristical interconnectedness with existing infrastructure. The mobile telephony network was able to connect with existing telephones and consequently, the concept of a critical mass was less important (Rogers, 2003). Businesses again quickly recognised the advantages that the mobile telephone could provide and could improve efficiency and communications as a result. Rogers (2003) even mentions how the mobile telephone saved a couple of hours per week for businessmen by allowing them cope with delayed schedules and busy agendas. While the mobile telephone in the shape of a car phone was fairly well established amongst the highest echelons of the social group during the early 1990s it is difficult to say just how this innovation was perceived. Furthermore, the car phone was hardly a “mobile” phone.

With the advent of the truly mobile telephone and the consequent drop in prices, from approximately €2000 in 1991 to being handed out for ‘free’ just five to seven years later (NRC, 04-01-1991; 28-04-1997), the diffusion of the innovation spurred forward. Furthermore, the mobile telephone was an easy to use artefact; it possessed a clear advantage over land-lines while retaining compatibility with existing infrastructure. Thus, there remained few obstacles in actually acquiring a mobile telephone. As a result, the mobile telephone also quickly found its way into the rest of society. The ease with which social capital could now be maintained and expanded meant that youngsters quickly found the mobile phone an indispensable artefact. With subscriptions lasting a relatively short time, old mobile telephones used by youngsters quickly found their way to other

members of households. Furthermore, because of the ease of the artefact itself the mobile telephone also rather easily diffused into older segments of society. Thus, very quickly the mobile telephone could be seen everywhere in society. Availability of the mobile telephone in terms of how easily the telephone can be acquired seems to play a lesser role than in terms of how cheaply the mobile telephone can be purchased, so price seems to be an important driver. Also, while the availability of the mobile telephone helped break its taboo, the congruence between values and beliefs offered by the artefact and those present in society seemed to be inherently closer than for other technological artefacts. This, no doubt helped the quick domestication of the mobile telephone in society.

The ease of communications as a basis for perceived indispensability is also seen in the acquisition of meanings and the way with which the mobile telephone was marketed throughout time. By the time the mobile telephone acquired more meaning, such as the camera-phone and integrated MP3 music format player, it was already considered to be indispensable in a large part of society. These additional meanings did little to change that. Instead, the acquisition of additional meaning was used as a smart marketing scheme to simply sell more mobile telephones. This is further evident from the diffusion numbers around the early 2000s when the mobile telephone market crashed. By this time, at least 75% of the Dutch population were using the mobile telephone, the introduction of additional features into the mobile telephone was considered to be a blessing for the mobile telephone industry as this allowed to increase sales volume once again. Thus, the mobile telephone was far less dependable on meanings imparted by society than the internet. Therefore, the 'need' for gadget-phones seemed entirely constructed by the mobile telephone industry.

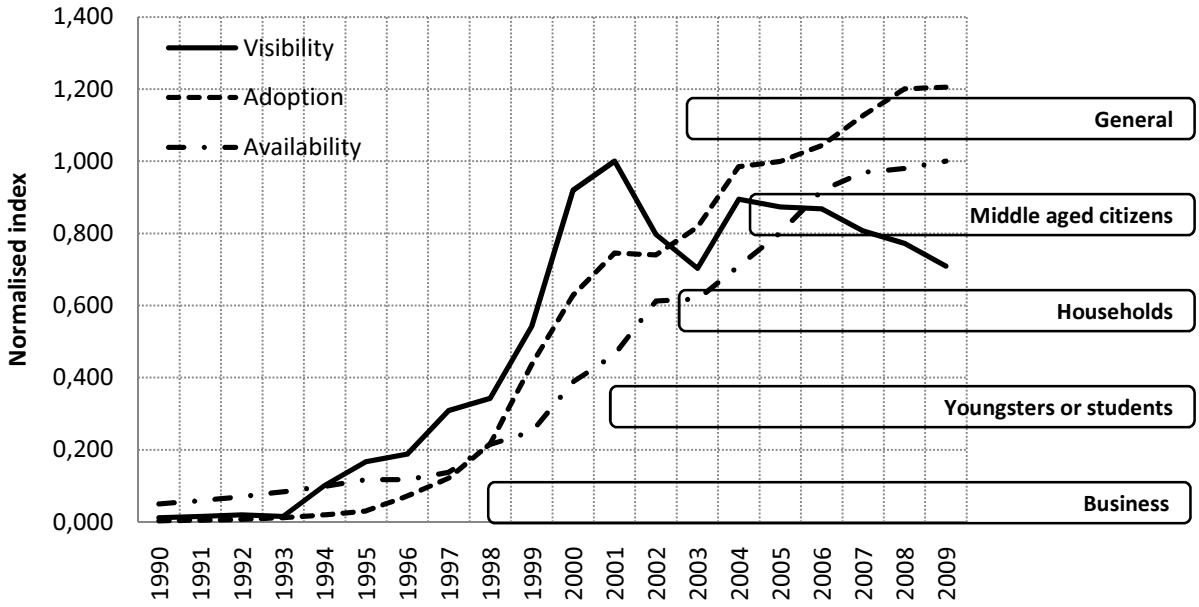

Figure 43: Indispensability amongst various social groups, visibility, adoption and availability of the mobile telephone (1990-2009).

Personal Computer

The personal computer (Figure 44) is the second physical artefact that was researched. It is also the first artefact that became indispensable in some form in society. Businesses considered the personal computer to be a workhorse as early as the 1990s. And judging by the mundane articles, the PC was indispensable in some sectors even before that. The narrative shows that the purpose of the personal computer in text and spreadsheet processing was considered to be an important aspect. It would however take a lot longer before the personal computer would become indispensable in the rest of society. Interesting enough, the first social group to perceive the personal computer as an indispensable artefact were households and in this sense differs from the previous innovations. There are a number of reasons for this; firstly, the innovation required substantial investment because it was expensive compared to the other two artefacts. Secondly, the personal computer was used extensively by computer-workers and the Dutch government stimulated the purchase of personal computers by providing financial incentives for the purchase of this item.

Nevertheless, it took almost seven years before the personal computer acquired this indispensability in the first place. This is best explained by the complexity of the innovation. Whereas computer-workers naturally had experience with the innovation, the lack of a graphical user interface required knowledge about command prompts and lines of code in order to operate. With the appearance of Microsoft's Windows 3.x and more notably, Windows 95, the personal computer became more accessible to the general public and the later operating systems also opened new possibilities as the personal computer slowly turned into a multimedia platform.

Although the Dutch government tried to stimulate computer use in education before this time, the lack of meaning and legitimacy stranded most ICT projects, and as a result educational institutions had to muddle through on their own instead. Finally, as software and computer literacy improved the personal computer made an appearance here, too. Shortly afterwards, the younger segment of society considered the personal computer as an indispensable artefact. In terms of indispensability however, something peculiar occurs with the personal computer during the early 2000s. Not only is the computer an invaluable tool for things such as word processing, but as the internet diffuses into society, the personal computer becomes more and more of a gateway to the internet. Thus, before the internet is truly regarded indispensable, it is rather the personal computer as a human-internet interface that is considered to be indispensable instead.

By the mid 2000s the personal computer is indispensable as a gateway to the internet, a 'library' for internet applications (such as online games, browsers, e-mail applications et cetera) and as a tool for the creation of online content. Over the years however, more technological artefacts are capable of interfacing with the internet. One example is the smart-phone, and in this sense, the personal computer loses some its importance as the monopolist as an internet interface.

Finally, we can see that the personal computer mostly acquires indispensability in older social groups because of its synergy with the internet; as it is still regarded as an otherwise complex artefact in these social groups. Furthermore, it implies that the previous meanings of the personal computer as gaming platform, multimedia platform, word processor et cetera are insufficient to pique interest from these social groups. And it is therefore interesting to question how the PC would be perceived by these social groups if it was not for the internet.

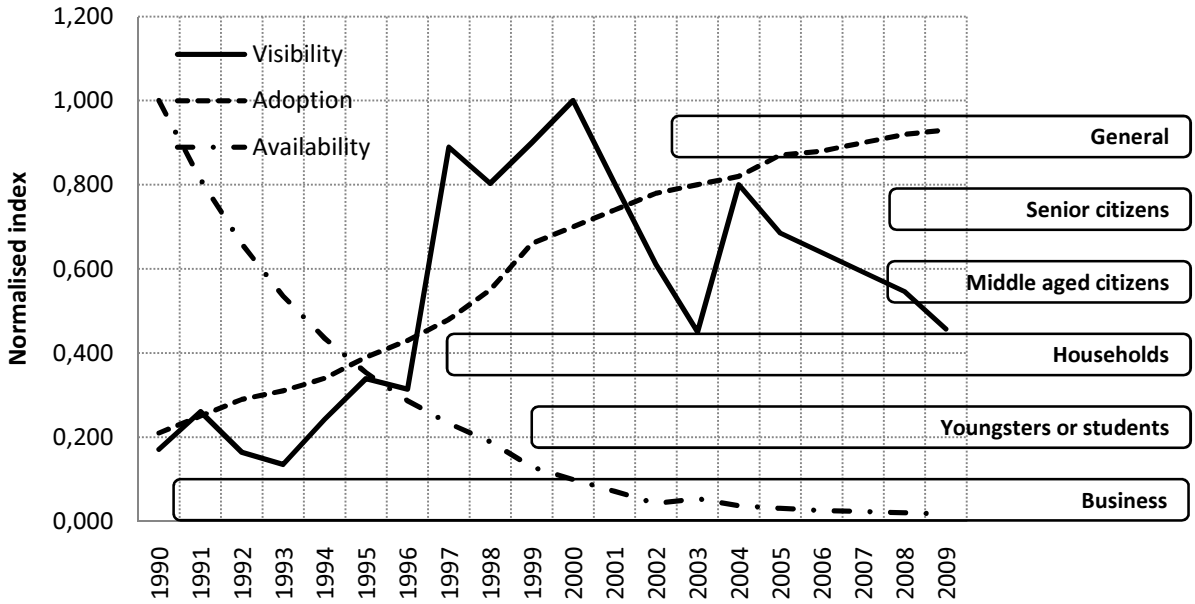

Figure 44: Indispensability amongst various social groups, visibility, adoption and availability of the personal computer (1990-2009) [53].

In sum, the internet began its life as an artefact that possessed very little meaning outside a select academic world. In contrast, the personal computer was already used by businesses and was considered to be a workhorse or at the very least a very handy tool. The mobile telephone also carried an inherent meaning because it was merely an expansion of existing telephony and simply added the comfort of mobility to an existing technology.

The internet seems to have become indispensable across various social groups as it acquired different meanings throughout these various social segments. Consequently, the entire packet of meanings and purposes forms the basis of the 'value' of the internet; as the internet acquired its meanings in every social layer the perceived value of the innovation rises. Because the innovation carries so much value and translates this into many daily rituals, it is also one of the reasons why deprivation of this technology is an extremely uncomfortable experience for subjects (Hoffman, 2009). Note however, that as the personal computer carries a primary role as an interface to the internet, loss of the personal computer must be equally distressing.

The mobile telephone possesses a slightly different nature in this respect. It is undoubtedly indispensable but mostly because of its primary purpose; telephony, or texting which also became very popular over the years. However, 'add-on' meanings provided by the mobile telephone industry seem to add little more to indispensability itself and instead are clever gimmicks to increase the sales volume of the mobile telephone in 'creating' artificial value. Or as Kotler (1990) describes so aptly: proper marketing can provide additional value to existing products, making it more likely that the product will sell.

[53] Note: although "availability" appears to decrease, this is actually not the case as availability here is based on the Consumer Price Index. The CPI drops as the development of the PC moves onward, thus lowering prices while at the same time increasing performance. Thus, a lower CPI implies "better availability" of the PC in society.

The personal computer was much vaunted in the past for its efficiency, financial applications, word and spreadsheet processing abilities. The artefact manages to retain these qualities over time, but its indispensability in society appears to have mostly transcended into a complex and interactive interface for users to connect to the internet. The personal computer also follows a slightly different initial diffusion pattern amongst social groups compared to the aforementioned technologies. The personal computer started out in the business environment like the previous innovations, but was diffused by the same social group into households. These are the so-called “computer-workers”, people that can do their work on a computer at home if necessary. The reason for this is that the personal computer was an expensive artefact and could not be easily acquired by young people (under the age of 25) themselves. This meant that the internet would first diffuse into the homes of the relevant working class. With the private PC project, supported by the Dutch government, the personal computer also diffused amongst those households that had no direct need for a personal computer. During these years, the mainstay of actions performed on personal computers were work related activities, text editing and entertainment. These meanings and uses seem to be fairly homogenous throughout computer users. After the diffusion of the internet however, and the increase in its number of meanings, the number of meanings for the personal computer also indirectly increased. However, by this time it was clear that given sufficient comfort and utility, the personal computer could be replaced by any other interface appliance that could facilitate access to the internet (such as a notebook, mobile phone or tablet PC).

5.2 Expectations and routines

The second item of comparison is the differences in expectations and routines as generated by the various technologies. In order to initially compare expectations and visibility of the various artefacts, I have placed these in proportion to each other by normalising visibility and normalising the total number of expectations against the total amount of visibility. Furthermore, they are placed in context of indispensability amongst the various social groups.

One thing that immediately comes to notice is the number of expectations generated before the internet hype of the 2000s. It should be kept in mind that although the number of expectations seems to exceed the number of articles this is not the case, however, the number of expectations during 1997, exceeds the number of expectations during 2000 but only as a proportion of visibility. As the internet became more visible in society a lot more acceptance was found for the innovation. Naturally, a large amount of negative discussions was still present but a number of utopian views emerged as well.

These utopian views (Figure 45) consequently increased interest, mobilised actors et cetera; the result of which can be seen in the increased amount of attention in general and the creation of the subsequent internet hype. As the technology matured over the years however, we see that the number of expectations gradually levelled out. At the same time, the number of instances where evidence of routinisation was found started to rise. No doubt, this is related to the number of meanings that the internet had and it is difficult establish to what amount expectations are responsible for routinisation. From the graph however, it would appear that at least in the case of the internet, expectations have little impact on routinisation and are responsible for an added level of perception instead. Furthermore, society seems to appreciate a more mundane character of an

artefact before it becomes indispensable. Arguably, this is due to the perceived familiarity of the artefact, after which the process of domestication and consequently, routinisation, can begin.

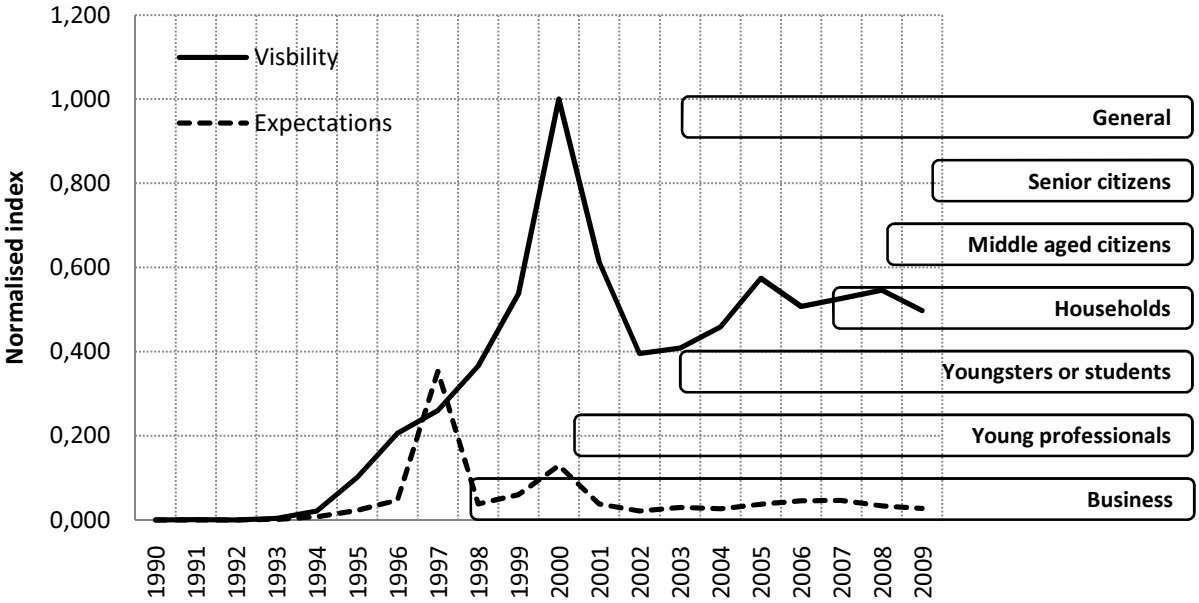

Figure 45: Visibility and expectations compared to indispensability patterns in society for the internet (1990-2009).

In terms of a non-dimensional "net" result, the following trend can be established (see Figure 46); whereas technological expectations remained fairly even over the years, the number of socially related expectations fluctuated. The early utopian views can be clearly seen as well as the more negatively dominant discourse regarding the free-for-all anarchy that the internet still constituted as late as 1998. Many individuals also believed that the internet was merely hype, thus the artefact received some negative attention in this respect. Nevertheless, the expectations during the hype period are also clearly visible.

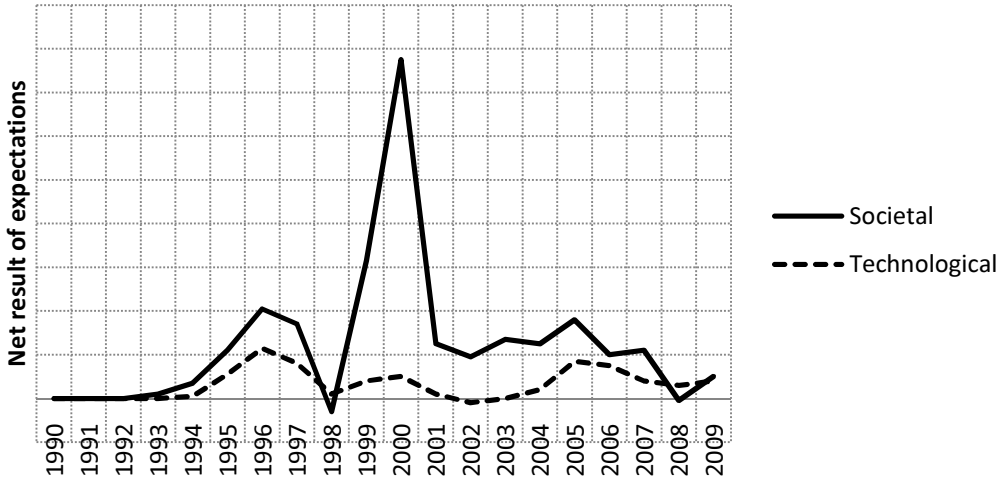

Figure 46: Net result of societal and technological expectations for the internet (1990-2009).

On the contrary to the internet, the expectations and visibility proportionally relate to one another for mobile telephones. This is likely the result of the character of the artefact. The mobile phone

possessed one meaning, and this inspired a sense of security as users knew what the artefact was for. Because the internet possessed a lack of meaning it was also easier to project utopian views and generate views that were 'impossible'; they could simply not be tested with reality. One similarity here again however is the mundane character of the mobile telephone after the peak in attention in 2001. The mobile telephone quickly becomes a commodity and as a result, expectations start to wane. Expectations are only refreshed again after mobile internet is introduced and the first smart-phones start appearing. A similar pattern can be discerned from other artefacts; the introduction of new meanings or features generates new expectations. Furthermore, the casual character of the mobile telephone is also visible in that social groups domesticated the artefact fairly quickly after expectations peaked, whereas this took a much longer time for the internet. Again, meaning appears to be a crucial factor.

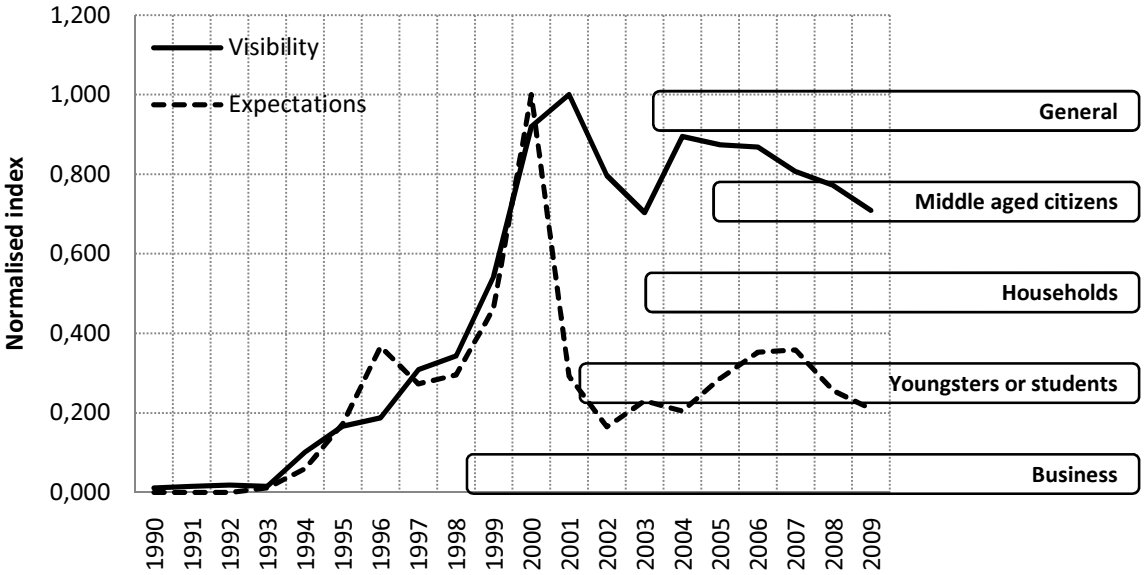

Figure 47: Visibility and expectations compared to indispensability patterns in society for mobile telephones (1990-2009).

Regarding the net result of the discourse on mobile telephones we see a very scattered pattern of societal expectations; which is vastly different from the quieter patterns for both the internet and personal computers. This is due to the fact that the mobile telephone saw several health scares related to radiation first, and then radiation from the UMTS system. Furthermore, the artefact introduced several societal issues which were not present before the mobile telephone. The speed with which life appeared to move forward, the constant connectivity, privacy as well as digital bullying; all of these issues played a role in the general discourse on the mobile telephone. One thing is clear from the graph however, the innovation became indispensable in most social groups after expectations acquired a calmer pattern.

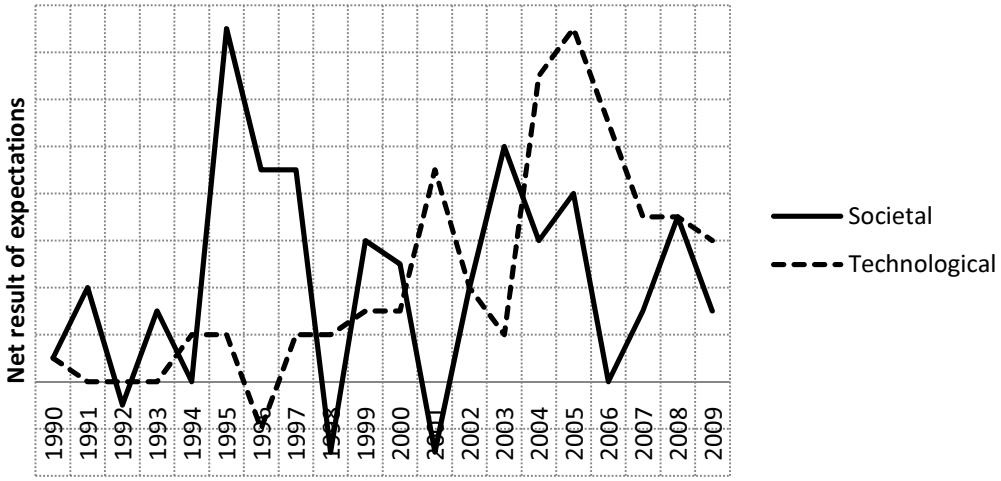

Figure 48: Net result of societal and technological expectations for mobile telephones (1990-2009).

Compared to the previous artefacts, the personal computer sees a very calm expectations pattern in proportion to its visibility throughout the years. This is because mostly, the personal computer was already physically visible in society, partly embedded and simply not as revolutionary by the time the internet and mobile telephony appeared. Furthermore, the personal computer is a relatively static item and is solely dependent on the software that it possesses. This also explains why the personal computer became much more interesting with the introduction of the internet. Consequently, the visibility of the personal computer in discourse proportionally rose with an increase in discourse on the internet. In addition, in terms of routines the personal computer relied more and more on the internet as the years progressed. No doubt, the artefact possessed great value in its practical applications, but the personal computer as a daily routine in society? This appeared only to take place with the subsequent domestication of the internet.

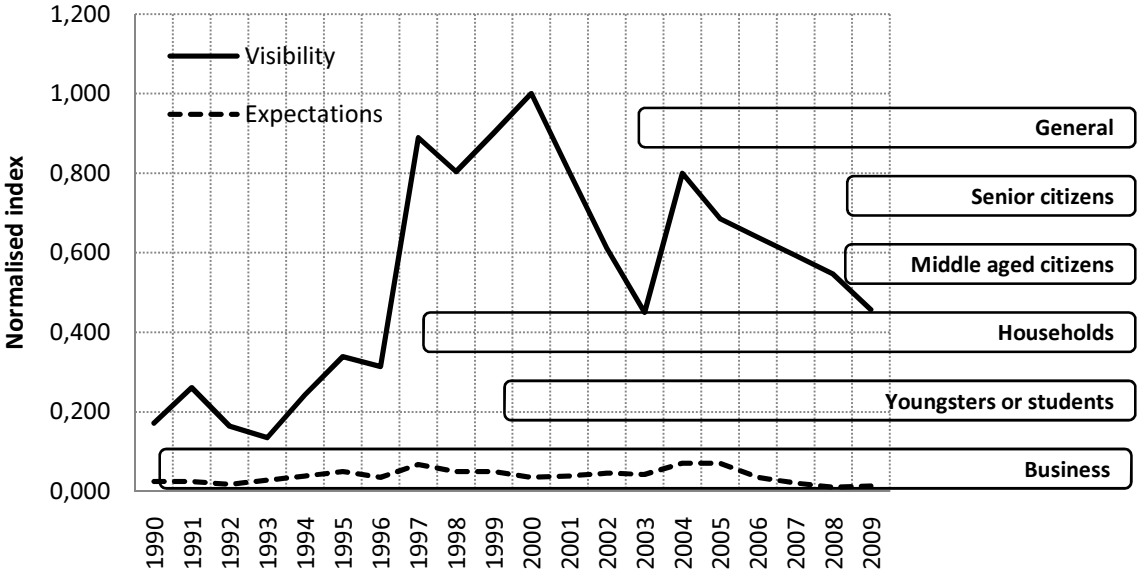

Figure 49: Visibility and expectations compared to indispensability patterns in society for personal computers (1990-2009).

Finally, in terms of net result the personal computer also possesses a fairly calm expectations pattern. The hype generated before and during the introduction of Microsoft's Windows 95 is clearly visible, but the personal computer quickly loses momentum afterwards. It should also be noted that compared with the other technologies, the personal computer's expectations were fairly low level. The low level of expectations is attributable to the mundane character of the artefact and this trend can be witnessed across other innovations as well once they reached the character of commodity rather than revolution.

Thus, whereas the internet and mobile phones are both quickly characterised by a number of "high-level" or "overarching" expectations as these place the artefacts in context of generic problems or promises (Van Lente & Spitters, 2009); this contrasts with the personal computer, which lost some of its visibility as it became a more common commodity. Instead, the personal computer was rather characterised by lower level and project specific expectations. It is interesting to note however that certain technological, product or project specific expectations (borderline hypes) tend to "reset" the discussion and generate new high level expectations as a result. This is especially visible with milestones such as Microsoft's Windows 95, the iPhone and Facebook.

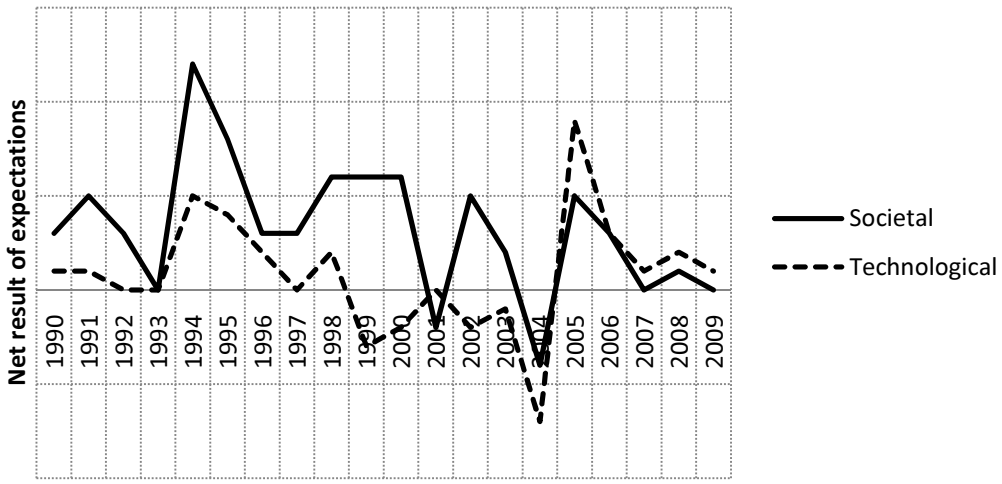

Figure 50: Net result of societal and technological expectations for personal computers (1990-2009).

6. Discussion and Conclusion

As ICT technology evolved through time it has become evident that this has greatly influenced our daily lives; society as we know it today thrives on these innovations, and our Google-Zeitgeist leaves little room for imagination what the world would look like without computers, the internet and mobile phones. We not only create technology for the fulfilment of our many needs - but technology directly affects our quality of life and well being; technology creates new needs where none existed before. Society and technology are shaped by each others' needs over time from which various meanings or patterns of use may emerge.

Starting from the beginning however, we see that the internet stood out; it possessed very little meaning and this was mostly limited to a tiny social group consisting of highly educated, very computer literate, academics and researchers, most of which were western males. The internet had trouble diffusing in the early years because of this lack of meaning and exploration was mostly limited to the innovators. Not only that, a long lasting problem with the internet has been the discrepancy between values and beliefs both online and offline. This hampered diffusion amongst social groups. The discourse revealed that most social groups were in fact not interested, had no need for it, and consequently watched the innovation with reserved suspicion. As the internet began to acquire meaning and visibility, it gained momentum in the sense that various internet champions and pioneers were broadcasting their utopian views about the internet into society. This confirms some of the mechanisms that are inherent to expectations, such as their performative power and ability to mobilise actors, which are described by Borup et al. (2005).

Furthermore some notions related to the social construction of technology (SCOT) were confirmed. Different social groups could be identified and a specific pattern of use and meanings was present amongst these. Furthermore, artefacts saw a stage of 'closure and stabilisation' as described by Klein & Kleinmann (2002), where the various social groups accepted that the innovation worked for them. This coincidentally appeared when congruence between values and beliefs emerged as described by Rogers (2003). This was quite visible throughout the researched technologies; initially, displayed interest in the internet was mostly limited to businesses, these gave the internet meaning as an efficient way to communicate and exchange information. As the internet caused the creation of many young businesses, often run by young entrepreneurs, it diffused amongst the younger section of the population first. Youth provided additional meanings in terms of the maintenance and creation of social capital as well as entertainment in the form of online gaming and the downloading of music and movies. While the internet slowly spread from one social group to another, households started discovering the potential of the internet as a comfortable application for their finances (online banking), leisure activities (information and booking of holidays) or relevant information provided by the government (taxes, insurance et cetera). From this, we can also discern that technology acquires meaning and relatable uses but not specifically in the context of "functions". In other words, meanings and functions should not be confused with one another. For example, whereas e-mail is a function of the internet, "efficient communications" or "upkeep of social capital" are meanings imparted by various social groups. Thus, the same artefact or function can have different meanings across society.

What is very interesting is the *spread* of meanings throughout various social groups. These meanings eventually diffuse throughout almost *all* social groups as the technology becomes mundane. This is especially evident in the later stages, where elderly people assimilate meanings initially acquired or created by other social groups. Furthermore it appears that social groups not only attribute meanings, but technology can create new meanings and patterns of use as well; this is especially evident with the introduction of "gadget-phones" by the mobile phone industry. In contrast, the mobile phone already possessed a very clear meaning at its introduction: communication. The only added aspect to the existing telephone was mobility, and this was very well sufficient for more than 75% of the Dutch population. However, in order to increase sales, the telephone industry introduced a variety of new meanings to the general public, such as photography, mobile internet et cetera. In essence, this is a modern example of the research that was done by Graber (2007), here mobile telephone producers artificially construct the need for functionality. Finally, some meanings can appear to be identical, but contain different patterns of use. This is also seen with the mobile telephone where the primary function is communications but each social groups interprets this meaning in their own way; business people recognise the power of mobile communication in order to stay in touch with their business continuously, whereas young people recognise its strength in maintaining and strengthening social capital easily, everywhere and all the time. For households and elderly people the mobile phone has similarly slight differences in communication. However, this is more of a question who communicates with whom, and in this sense these "meanings" do not diffuse, for example: most elderly people are not likely to have the need to stay in touch with their business. Thus, the same meaning can be routinised in a different way across various social groups.

Whereas the internet and mobile phones have a good deal of visibility, the personal computer is a bit of an oddity. While it was undoubtedly indispensible in various professional environments, where the need for a large amount of complex calculations was required, or where it added significant benefit over older routines, such as photo and video manipulation. The personal computer in public society was not deemed as important until it formed a synergy with the internet. From that moment on, the personal computer became a gateway - a sophisticated human machine interface - for access to the internet. Before that, the personal computer was indispensable fairly early on, and was integrated in routines years earlier. This resulted in the artefact acquiring a sense of 'mundanity' which actually resulted in less appreciation and visibility for the technology, at least until the artefact acquired a new use. Thus, new meanings seem to "refresh" the importance of artefacts and may yield them indispensable in new ways; this seems attributable to the mechanics of routines.

How do meanings relate to indispensability and routines then? As an innovation acquires more meanings from its various social groups, the perceived *value* of the innovation seems to rise. This is pretty much the same as in the marketing of a product. If a product is marketed well and given value over existing products, it is more likely that it will sell (Kotler, 1999). Thus, if a product acquires new meanings, the perceived value of the innovation will rise and depending on the perceived attributes of the innovation such as relative advantage, compatibility and complexity as described by Rogers (2003), the innovation will start replacing existing routines. In essence, the meanings that social groups attribute to innovations seem to be new sets of potential routines. Consequently, the immense value that something such as the internet possesses, as well as the combination of many routines that it replaces: e-mail instead of "real-life" correspondence; movie downloads instead of renting videos; news online instead of newspapers; booking holidays online instead of having to visit

a travel agent and potentially pay more for the same service; ordering items online instead of having to visit the store; staying in touch with more and older contacts than would be physically possible "offline"; and much more, results in the innovation becoming indispensable. It allows performing these routines at greater efficiency than previously possible. Furthermore, an observation made during this research, is that routines reduce the opacity of an innovation. Whereas an innovation is extremely "visible" in the early stages of diffusion, in the sense that people dwell on its implications and possible uses; as the use of the innovation becomes routinised, the innovation loses opacity until use of the innovation is no longer a conscious action. Therefore, it would seem that routinisation makes innovations indispensable, but this alone falls short, as existing routines can easily be replaced by new routines. Instead, we also have to consider the value attributed to the innovation and the value of the subsequent routines over old ones. Indeed, indispensability, meanings, routines and value seem to be closely related.

Following the reconstructed narrative, dynamics and comparison on the technologies, I proceed to answer the research question:

"How and when have ICT artefacts transformed from 'novelty' to 'indispensable-technology' in the Netherlands from 1990-2009?"

It is clear that different ICT technologies show a different pattern towards indispensability and that this even differentiates between social groups. The process with which a technology becomes indispensable depends on whether potential users have an idea of the meaning of the innovation, or whether they can create their own set of meanings. Furthermore, it is a question of how many potential meanings the technology possesses, the potential value of each meaning and routine; and, is it even about meaning or is it collective utility? Perhaps it may be a question of whether an innovation forms a certain synergy with other related innovations, just like the personal computer and mobile phone formed their synergy with the internet as human machine interfaces. Or even how the mobile phone and personal computer formed a synergy with each other, where for example, digital photos taken with a mobile phone could be uploaded to a PC and subsequently modified.

Thus, how have ICT artefacts become indispensable? Indispensability first of all occurs in different social groups at different times. Keeping this in mind, indispensability arose when these respective social groups attributed a set of *meanings* to an innovation. However, these meanings required *routinisation* in order to be assimilated in every day practices. There is a general sense of loss that is tied to an indispensable artefact being unavailable. Thus, routines provide a sense of essentiality to the artefact. Because a meaning is only as important as the value attributed to this and routines are easily replaced, one other very important concept is the *value* or *quality* attributed to both meanings and routines. Some meanings are more important than others, especially across different social groups. This is for example visible between how businesses and say households regard communications technology. Businesses have great interest in the communications and efficiency aspect of said artefacts while households for example favour common utility, and youngsters specifically appreciate the upkeep of social capital.

Furthermore, society seems to require a stable environment in terms of discourse for a technology to become 'trusted'. Trust generally lowers the threshold for social groups to experiment with the artefact. And, technologies that are difficult to accept or trust, or when there is a visible amount of societal resistance, showed that it took longer for them to become indispensable. Two visible examples here are the internet and mobile telephony; it took much longer for the internet to be recognised at all, than say a mobile telephone, as we were already familiar with the concept of telephony itself.

Thus in summary: as social groups attributed *meanings*, *routinised* these, and the cumulative *value* of both could not be replaced by other artefacts or lower quality routines, the technology becomes indispensable. However, it should be kept in mind that if society does not trust the artefact, it will not (easily) become embedded in routines. Moreover, if there is no meaning to the artefact in question, there can be no need.

As to the "when"; it is possible - based on the discourse - to identify certain points in time when an artefact has become indispensable. However, in order to really grasp the "when", we need to look at the process of indispensability rather than the tipping point. It is of little use saying an artefact has become indispensable at a certain point in time. Instead, indispensability is a gradual spread that on a macro-scale differs from one artefact to another, meso-scale from one social group to another and at micro-scale even from one individual to another. Strictly looking at social groups however, indispensability seems to emerge at different times throughout these different social groups. This is because some meanings may have already been routinised within one social group, while not even having been diffused into another. Therefore, the time until "general" indispensability of an artefact in society occurs, depends on the time that it takes for these meanings to diffuse in social groups. Of course, there may never be "complete" indispensability because not all social groups acquire all meanings from one another. Within specific social groups however, a process towards indispensability can be observed and this is related to when meanings become valuable and when routinisation of these meanings within the social group occurs. Furthermore, this process occurs when society, or at least, social groups have established closure with an artefact and trust the artefact in question. After establishing these, the artefact can be readily domesticated which commences the process towards indispensability as its attributes are routinised.

How does this relate to our exploratory framework? Indispensability of ICT artefacts emerges when enough people have access to it, as this creates interconnectivity, collective utility and network externalities. Thus, the amount of adoptees is a crucial factor; but it should be kept in mind that this is not a question of the overall number of adoptees but rather of the number of adoptees within a social group. A technology may become well indispensable to one social group whereas general adoption of an artefact is still low; this naturally differs from the initial notion that an innovation has to be fully diffused across society in order to become indispensable. However, an important consideration here is that indispensability does not equal diffusion, if a well diffused artefact can be replaced by a similar artefact with potentially higher quality meanings and/ or routines, then indispensability is not necessarily a given fact. This is for example evident with the "slight loss" of perceived indispensability of the personal computer as it lost its monopoly as an interface to the internet despite the fact that the artefact had diffused throughout much of society.

Availability facilitates adoption in the way that if a service is highly available and easily accessible, it is much more likely to spread quicker and therefore influence the speed with which its routines are adopted. Furthermore, a lack of accessibility or availability seems to be almost synonymous with a lack of compatibility between values and beliefs of the general public: "why would I need *that*?" Once the artefact is readily accessible however, it can be more easily trialed by potential users and therefore becomes easier to test these values and beliefs: "everybody's using it!". In this sense, high availability and related notions such as high or easy trialability are present for an indispensable ICT artefact.

With regards to routines, old routines are supplanted by new ones. These new routines possess greater quality and or value than the previous ones. Therefore, it is not a matter of quantity, but rather quality. Whether these routines are actually replaced depends on congruence between current beliefs and values and whether they actually provide greater value and or quality. Is there a high amount of routines present when an innovation becomes indispensable? Not necessarily. However, the routines that are part of the artefact do possess greater quality than previous ones. This is perhaps best illustrated with the example of e-mail, which replaced most, if not all physical correspondence in businesses over time as it was more efficient. On a related note, technologies that are in their infancy or in the process of being routinised enjoy a higher (quality of) visibility in discourse than ones that are already established. However, as the technology becomes indispensable and is subsequently domesticated, the amount of attention may decrease or level out. At this time, the discourse regarding an artefact becomes more "casual". As a result, the artefact actually loses visibility in discourse as it is a simple mundane object; which is contrary to the assumption made in the exploratory framework. This is also related to routines in the sense that the routines themselves lose opacity and the use of the artefact becomes a subconscious action rather than a conscious one.

Expectations in turn possess their own quality to influence the speed with which something becomes indispensable or even how it becomes indispensable. Negative expectations, most evidently with the internet, influenced the rate of adoption and subsequent indispensability, due to the fact that they broadened the distance between values and beliefs online and offline. However, positive expectations in turn showed the amount of possibilities and potential meanings that the internet could have; it would only be a matter of time before the first innovators would pick up on this and physically create services that allowed for online financial transactions, search engines, news services, YouTube et cetera. However, once the technology has been sufficiently domesticated, both negative and positive effects do not seem to have any more substantial effects on further domestication. Thus, expectations appear to be critical only in the initial stages of the diffusion of an innovation or new service. This is also visible in the discourse where a lot of expectations and negative discourse on privacy and security issues did not influence subsequent adoption. The public thought that the general idea was that the technology is safe as long you know what you are doing. On the other hand, these expectations did cause slight changes in existing routines, so that people would care more for their security and privacy online. Expectations therefore never really seem to lose their performative power throughout time. Also, when an artefact is first introduced into society it is generally characterised by "over-arching" expectations and societal debates. During its evolution, gradually lower level expectations are introduced. These expectations however, regardless of their level or nature (positive, negative, societal, technological), possess performative power.

What does this mean for the spread of future ICT innovations then? Innovations that initially have little meaning would benefit from being spread over a wide social base so that they quickly acquire multiple meanings and accumulate value or should inherit multiple or high quality meanings from marketing. This increases the perceived importance of the innovation and during deprivation, people will realise that they are dependent upon the artefact. Additional meaning cannot be introduced too quickly however, because social groups will try to catch up with existing ones before attempting to assimilate new ones. For an innovation that possesses an inherent meaning, it is beneficial to have an infrastructure in place, or at least facilitate interconnectivity with an existing one so as to quickly stimulate reciprocal interdependence.

Lastly, I wanted to contribute to existing literature on innovation and needs. I felt that the entire concept of needs is somewhat neglected in innovation literature, or at the very least not very explicitly mentioned. This research showed that needs very well modify our perception of technology and go beyond “something that needs to be fulfilled”.

In the meanwhile, I also realise that this research was fairly exploratory in nature and I believe that points of improvement that can be made. Firstly, I would recommend that for future research, more diverse innovations are investigated. In addition, I think that in hindsight research would also benefit if these innovations are from an unrelated technological domain i.e. not “just” information and communications technology. In order to see what differences these domains offer in terms of indispensability Secondly, a deeper focus into social groups may reveal more specific mechanics tied to different social groups in the way that social groups attribute or acquire meaning, attribute value and routinise the artefact. Using general discourse itself felt like a rather blunt instrument so in this sense adding interviews might have created additional depth. However, I also realise that these interviews would need to be performed over time as indispensability is a process rather than a tipping point.

Bibliography

Abbring J.H., Van Ours J.C. (1994) "*Selling news and advertising space: the economics of Dutch newspapers*", De economist (142/2) p. 151-170

Abernathy W.J., Clark K.B. (1985) "*Innovation: Mapping the winds of creative destruction*", Research Policy 14 (1985) p. 3-22

Barranco J., Wisler D. (1999) "*Validity and systematicy of newspaper data in event analysis*", European sociological review (15/3) p. 301-322

Borup M., Brown N., Konrad K., Lente H. van (2006) "*The sociology of expectations in science and technology*", Technology Analysis and Strategic Management 18 (3&4) (2006) p. 285-298

Brem A., Voigt K.I. (2009) "*Integration of market pull and technology push in the corporate front end and innovation management—Insights from the German software industry*", Technovation 29 (2009) p. 351-367

Bryce J., Rutter J. (2003) "*Gender dynamics and the social and spatial organisation of computer gaming*", Leisure Studies (22) 1, p. 1-15

Burkhardt M.E., Brass D.J. (1990) "*Changing patterns or patterns of change: The effects of a change in technology on social network structure and power*" Administrative science quarterly (35) p. 104-127

Chareongwongsak K. (2002) "*Globalization and technology: how will they change society?*" Technology in Society (24) p. 191-206

Du H.S., Wagner C. (2006) "*Weblog success: Exploring the role of technology*", Int. J. Human-Computer Studies (64), 2006, p. 789-798

Frissen V. (2004) "*De domesticatie van de digitale wereld*", LIFT- Fonds TNO, Faculteit der Wijsbegeerte, Erasmus Universiteit Rotterdam, 25 June 2004

Geels F.W., Pieters T., Snelders S. (2007) "*Cultural enthusiasm, resistance and the societal embedding of new technologies: psychotropic drugs in the 20th century*" Technology Analysis & Strategic Management (19) p. 145-165

Graber F. (2007) "*Inventing needs: expertise and water supply in late eighteenth- and early nineteenth-century Paris*", British Journal for the History of Science 40(3) (2007) p. 315-332

Guice J. (1999) "*Designing the future: the culture of new trends in science and technology*", Research Policy (28) p. 81-98

Hoeve A., Nieuwenhuis L.F.M. (2006) "*Learning routines in innovation processes"*, Journal of Workplace Learning (vol 18 No 3), 2006, p. 171-185

Hoffman D.L. (2009) "*Internet Indispensability, Online Social Capital, and Consumer Well-Being*", University of California, Riverside, Chapter prepared for the section "Technological Fronts" in the book *Transformative Consumer Research for Personal and Collective Well Being: Reviews and Frontiers* (Editors: David Mick, Simone Pettigrew, Connie Pechmann, and Julie Ozanne)

Hoffman D.L., Novak T.P., Venkatesh A. (2004) "*Has the internet become indispensable?*", communications of the ACM (vol 47 No 7), July 2007, p. 37-42

Howells J. (1997) "*Rethinking the market – technology relationship for innovation*", Research Policy (25) p. 1209-1219

Keller R. (2005) *"Analysing discourse. An approach from the sociology of knowledge",* Forum: Qualitative Social Research (Vol 6 No 3 Art 32), September 2005, p. 1-14

Klein H.K., Kleinman D.L. (2002) "*The Social Construction of Technology: Structural Considerations"*, Science, Technology and Human Values (Vol 27 No 1), Winter 2002, p. 28-52

Kotler P., Armstrong G., Saunders J., Wong V. (1999) "*Principles of Marketing*", Second European Edition, Prentice Hall Europe (1999), New Jersey, ISBN 0-13-262254-8

Kuo F.F. (1977) "*Defense Data Networks – Common-User or Dedicated?*", SIGCOMM '77, Proceedings of the fifth symposium on data communications, ACM, New York, 1977, p. 1-3

Lacohée H., Wakeford N., Pearson I. (2003) "*A social history of the mobile telephone with a view of its future*", BT Technology Journal (21) 3, July 2003, p. 203-211

Leiner B.M., Cerf V.G., Clark D.D., Kahn R.E., Kleinrock L., Lynch D.C., Postel J., Roberts L.G., Wolff S.S. (1997) "*The past and future history of the internet*", Communications of the ACM 40 (2), February 1997, p. 102-108

Leiner B.M., Cerf V.G., Clark D.D., Kahn R.E., Kleinrock L., Lynch D.C., Postel J., Roberts L.G., Wolff S.S. (2009) "*A brief history of the internet*", ACM SIGCOMM Computer Communication Review 39 (5), October 2009, p. 22-31

Lester D. (1990) "*Maslow's hierarchy of needs and personality*", Personality and Individual Differences 11(11) (1990) p. 1187-1188

Lundvall B.A. (1985) "*Product Innovation and User-Producer Interaction"*, Industrial Development Research Series (31), Aalborg University Press (1985), ISBN 87-7307-304-0

McGuigan J. (2005) "*Towards a sociology of the Mobile Phone*", In Human Technology: An interdisciplinary journal on humans in ICT environments (1) 1, April 2005, Ed. Pertti Saariluoma, Agora Center, Jyväskyla University, ISSN: 1795-6889

NET-IS (Network for Teaching Information Society "*Information Society: From Theory to Political Practice*", Gondolat – Új Mandátum, Budapest, 2008

Perelman D. (2008) "*Americans can't stay disconnected*", eWeek; 25 (10) (2008) p. 52

Pertierra R. (2005) "*Mobile Phones, Identity and Discursive Intimacy*", In Human Technology: An interdisciplinary journal on humans in ICT environments (1) 1, April 2005, Ed. Pertti Saariluoma, Agora Center, Jyväskyla University, ISSN: 1795-6889

Pinch T.J., Bijker W.E. (1984) "*The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other*" Social Studies of Science (14) 3, August 1984, p. 399-441

Preti A. (2008) "*School Shooting as a Culturally Enforced Way of Expressing Suicidal Hostile Intentions*", J Am Acad Psychiatry Law (36), 2008, p. 544-550

Rainie L., Fox S., Fallows D. (2003) "*THE INTERNET AND THE IRAQ WAR HOW ONLINE AMERICANS HAVE USED THE INTERNET TO LEARN WAR NEWS, UNDERSTAND EVENTS, AND PROMOTE THEIR VIEWS",* PEW Internet & American life project, 1100 Connecticut Avenue, Suite 710, Washington, D.C. 20036, 202.296.0019

Rinaldi A. (2009) "*Science wikinomics: Mass networking through the web creates new forms of scientific collaboration*", EMBO reports (10), 2009, p. 439-443

Rivers T.J. (2008) "*Technology's role in the confusion of needs and wants*", Technology in society (30), p. 104-109

Robertson T.S., Gatignon H. (1986) "*Competitive Effects on Technology Diffusion*", Journal of Marketing (50), July 1986, p. 1-12

Rogers E.M. (2003) "*Diffusion of Innovations*", Fifth Edition, Free Press New York, ISBN (10): 0-7432-2209-1

Rosenberg N. (1976) "*On technological expectations*", The economic journal (86), p. 523-535

Ruef A., Markard J. (2006) "What happens after a hype? Changing expectations and their effect on innovation activities in the case of stationary fuel cells", EASST Conference 2006, August 23-26, University of Lausanne, p. 1-19

Ruef A., Markard J. (2010) "*What happens after a hype? How changing expectations affected innovation activities in the case of stationary fuel cells*", Technology Analysis & Strategic Management (Vol 22 No 3), April 2010, p. 317-338

Rustema R. (2001) "*The Rise and Fall of DDS: evaluating the ambitions of Amsterdam's Digital City*", Doctoral Thesis in the Communication Science, University of Amsterdam, November 2001

Shida R.Y., Gater W. (2007) "*I Tune, You Tube, We Rule*", CAP Journal (1) 1, October 2007, p. 30-31

Tidd J., Bessant J., Pavitt K. (2005) "*Managing innovation: integrating technological, market and organisational change*", Third Edition, John Wiley & Sons, Ltd, Hoboken, ISBN (10): 0-470-09326-9

Tscherning H., Damsgaard J. (2008) "*Understanding the Diffusion and Adoption of Telecommunication Innovations: What We Know and What We Don't Know*", In IFIP International Federation for Information Processing, Volume 287, Open IT-Based Innovation: Moving Towards Cooperative IT Transfer and Knowledge Diffusion, eds. León, G., Bernardos, A., Casar, J., Kautz, K., and DeGross, J. (Boston: Springer), p. 41-62.

U.S. Patent 4,144,411 -- *Cellular Radiotelephone System for Different Cell Sizes* -- Richard H. Frenkiel (Bell Labs), filed Sep 22, 1976, issued March 13, 1979

Van Lente H., Rip A. (1998) "*The rise of membrane technology: from rhetorics to social reality*", Social studies of science (28/2) p. 221-254

Van Lente, H. (2009) *"The Needs of Innovation" ,* Proposal Responsible Innovation, NWO, 2009

Van Lente H., Spitters C. (2009) "*Comparing technological hype cycles: towards a theory*", paper prepared for the workshop 'expectation building and innovation processes 17 and 18 september 2009, Dübendorf (Zürich), Switzerland, p. 1-32

Van Merkerk R.O., Robinson D.K.R (2006) "*Characterising the emergence of a technological field: expectations, agendas and networks in Lab-on-a-chip technologies.*" Technology Analysis and Strategic Management. 18(3/4) p. 411-428"

Von Hippel E., (1986) "*LEAD USERS: A SOURCE OF NOVEL PRODUCT CONCEPTS"*, Management Science (Vol 32 No 7), July 1986, p. 791-805

Internet Sources:

BBC, 8 March 2010, Internet access is 'a fundamental right':
http://news.bbc.co.uk/2/hi/technology/8548190.stm

BBC, 14 January 2011, Tunisia protests: cyber war mirrors unrest on the streets:
http://www.bbc.co.uk/news/world-africa-12180954

BBC, 28 January 2011, Egypt severs internet connection amid growing unrest:
http://www.bbc.co.uk/news/technology-12306041).

The Bottom Line, 2008, Cell Phone Dependency Causes Disconnection:
http://thebottomline.as.ucsb.edu/2008/05/cell-phone-dependency-causes-disconnection-by-nicole-richards

Centraal Bureau voor de Statistiek, 2010, Vestigingen naar activiteit, provincie en corop:
http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLNL&PA=03760ed&D1=0,5-16&D2=678&D3=a,!0&HD=100828-1530&HDR=T&STB=G1,G2

Central Bureau for Statistics, Mobiele Telefonie Volledig Ingeburgerd, 20 June 2007:
http://www.cbs.nl/nl-NL/menu/themas/bedrijven/publicaties/digitale-economie/artikelen/2007-2214-wm.htm

Centraal Bureau voor de Statistiek, 2010, ICT gebruik van huishoudens naar huishoudkenmerken:
http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLNL&PA=71102ned&D1=a&D2=0&D3=(l-11)-l&HD=080901-1401

Centraal Bureau voor de Statistiek, 27 June 2007, Mobiele telefonie volledig ingeburgerd:
http://www.cbs.nl/nl-NL/menu/themas/bedrijven/publicaties/digitale-economie/artikelen/2007-2214-wm.htm

Centraal Bureau voor de Statistiek, 2010, PC use 1990-1998, Historie inkomen, vermogen en consumptie:
http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=37662&D1=34&D2=71-82&HDR=T&STB=G1&VW=T

Centraal Bureau voor de Statistiek, 2010, PC use 1999-2004, Media en ICT; gebruik televisie, krant, PC en internet:
http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=70655ned&D1=11-16,53-71,146&D2=0-2&D3=a&VW=T

Centraal Bureau voor de Statistiek, 2010, PC use 2005-2009, ICT gebruik van personen naar persoonskenmerken:
http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=71098ned&D1=0-32,55,60&D2=0-2&D3=a&VW=T

Centraal Bureau voor de Statistiek, 2011, Internet use (1998-2000):
http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=70655ned&D1=11-12,14-15,17-52,72-147&D2=0-2&D3=a&VW=T

Central Bureau voor de Statistiek, 2010:
http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLNL&PA=03760ed&D1=0,5-16&D2=678&D3=a,!0&HD=100828-1530&HDR=T&STB=G1,G2
Centraal Bureau voor de Statistiek, 2011, ICT gebruik van personen naar persoonskenmerken:
http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=71098ned&D1=33-133&D2=0-2&D3=a&VW=T
The Daily of the University of Washington, 22 June 2009, Iran protests: the internet comes of age:
http://dailyuw.com/2009/6/22/iran-protests-internet-comes-age/
The Eighties Club, 2000, Jason Manning, The Computer Revolution:
http://eightiesclub.tripod.com/id325.htm
Foundation for Computer Heritage Netherlands (SCEN), On behalf of the appraisal commission National Register Historical Computers by dr. Gerard Alberts and dr. Willem Melching, 2011:
http://www.computer-erfgoed.nl/computergeschiedenis_volg_3.htm
Hobbes' Internet Timeline, Robert H. Zakon, 2010:
http://www.zakon.org/robert/internet/timeline
Hoofdbedrijfsschap Detailhandel, 2010, aantal telecomzaken:
http://www.hbd.nl/pages/15/Winkels/Telecomzaken/Aantal-winkels.html?subonderwerp_id=743
IEEE Global History Network, 10 September 2008, Jack Kilby: Biography:
http://www.ieeeghn.org/wiki/index.php/Jack_Kilby
IIPS, The Spread of Information Technology and Change in Society, 2003:
http://www.iips.org/Viewpoint_Hiroki.pdf
Internet Society (ISOC), linked to History of the Internet, 2010:
http://www.historyofthings.com/history-of-the-internet
Geschiedenis van het Internet, onwikkeling computer 1984, Centrum voor Wiskunde en Informatica, Mathematisch Centrum, NRC Handelsblad, 26 September 1984, Pauline van der Ven:
http://web.inter.nl.net/users/pauline/InternetArtikel1984.pdf
Kool et al. (2009), Marktrapportage Elektronische Communicatie September 2009:
http://www.rijksoverheid.nl/documenten-en-publicaties/rapporten/2009/11/01/marktrapportage-elektronische-communicatie.html
Nederland Breedbandland, 2005, Netwerken in cijfers, Kwartaalrapportage mart 2005, Ministerie van Economische Zaken, TNO Delft:
http://www.nederlandbreedbandland.nl/uploaded/FILES/netwerken_in_cijfers_2005.pdf
New York Times, 4 september 2003: Adding eye contact to your web chats:
http://www.nytimes.com/2003/09/04/technology/basics-adding-eye-contact-to-your-web-chats.html
NLNet, Foundation History, 2011:
http://www.nlnet.nl/foundation/history/
NLNet, Annual Report 2009, 2009:
http://www.nlnet.nl/foundation/annuals/2009-annual-report.pdf
NRC Handelsblad 1990-2009 (Accessed through LexisNexis archive):
http://academic.lexisnexis.nl.proxy.library.uu.nl/uu/
Operation Iraqi freedom and Operation Enduring Freedom casualties, 2009:
http://www.icasualties.org/
Oxford Dictionary, 2010:
http://oxforddictionaries.com
Price Waterhouse Coopers, 2011, Mobile Advertising:
http://www.pwc.com/nl/nl/publicaties/mobile-advertising.jhtml
Rijksoverheid, Marktrapportage Elektronische Communicatie - TNO - September 2009:
http://www.rijksoverheid.nl/bestanden/documenten-en-publicaties/rapporten/2009/11/01/marktrapportage-elektronische-communicatie/35088-mec-september-def.pdf
Spits Nieuws, '#deomeisje' leidt tot commotie, 18 February 2011:
http://www.spitsnieuws.nl/archives/binnenland/2011/02/deomeisje_leidt_tot_commotie.html
Stichting Internet Domein Registratie (SIDN), 2010:

https://www.sidn.nl/fileadmin/docs/PDF-files_NL/Website%20stats%202010-07%20NL.pdf

Stichting Internet Domein Registratie (SIDN), 2010, Alles Over Domeinnamen (accessed via):
http://www.internetten.nl/div/document.asp?id=9593&m=4&kleur=blauw

SURFnet, 2011:
http://www.surfnet.nl/nl/publicaties/Overig/Pages/Twintigjaargrensverleggendnetwerken.aspx

Tech Liberty NZ, 2010, Internet Disconnection is Not an Option:
http://techliberty.org.nz/internet-disconnection-is-not-an-option/

Time, The YouTube War, Ana Marie Cox, 19 July 2006:
http://www.time.com/time/nation/article/0,8599,1216501,00.html

TopBitz,com, 2011, History of Cell Phones:
http://www.tech-faq.com/history-of-cell-phones.html

United States Bureau of Labor Statistics, 16 October 2001, Quality-Adjusting Computer Prices in the Producer Price Index: An Overview, Michael Holdway:
http://www.bls.gov/ppi/ppicomqa.htm

United States Bureau of Labor Statistics, 2010, Consumer Price Index of Personal Computers (all urban consumers):
http://data.bls.gov/PDQ/servlet/SurveyOutputServlet

Volkskrant.nl, 16 April 2010, D-66 congres: Internettoegang is grondrecht:
http://www.volkskrant.nl/multimedia/article1370442.ece/D66-congres_internettoegang_is_grondrecht

A.D. Williams , Wikinomics: How Mass Collaboration Changes Everything, IT@Cork, 28 November 2007:
http://www.itcork.ie/contentfiles/eventresources/AWilliams.pdf

Webdesigner Depot, 2011, The evolution of cell phone design between 1993-2009:
http://www.webdesignerdepot.com/2009/05/the-evolution-of-cell-phone-design-between-1983-2009/

Webhosting Info, Domeinnamen voor Particulieren: de feiten, 2010:
http://www.webhostinginfo.nl/artikelen/gebruiksrecht-particulieren.php

XS4ALL, Geschiedenis, 2011:
http://www.xs4all.nl/overxs4all/geschiedenis/

Appendix A: Expectations and Statements in Detail

Table 4: Expectations and Statements classification codes.

Value	Description	Example gathered in preliminary analysis (1998-2000)
	Societal discourse	
Very negative expectations or statements in social context (S1) (-2x weight in net result)	The message contains negative superlatives, strong (post hype) disappointment about the respective technology or incurs heavy social resistance against the technology from the potential user base, governments et cetera. Examples include severe criminal abuse, severe impairment of freedom of speech, freedom of use, severe privacy issues, or major health concerns	"For two thirds of the Dutch people that are not active on the digital highway, the internet is a difficult medium. In addition, they question the importance of the internet which they consider to be hype" (NRC Handelsblad, April 19, 2000, Pg. 21, 389 words).
Negative expectations or statements in social context (S2) (-1x weight in net result)	Negative statements or social concern about the respective technology. Issues include criminality, freedom of speech, freedom of use, privacy, health concerns	-
Contains both positive and negative elements (S3) (no weight in net result)	A discussion characterised by negative and positive elements. These may include the terms above (criminality, freedom of speech, privacy et cetera) but are followed/counteracted by more positive statements.	"The intensification that internet providers are required to do in order to help the justice department track criminal internet users will consequently increase the subscription fees for access of the internet" (NRC Handelsblad, December 5, 2000, Pg. 19, 129 words).
Positive expectations or statements in social context (S4) (+1x weight in net result)	Characterised by positive statements where a beneficial effect can be traced. This can include positive predictions and power statements or the positive influence of technology on society (higher work efficiency, social networking, increased consumer comfort etc.) Breakthroughs are absent.	"Websites, personal pages on the internet, where political parties can communicate with the public without intervention of journalists will play a central role. They will form the "heart" of the "ultramodern" campaign, says PvdA (Labour Party) researcher Anker" (NRC Handelsblad, December 15, 1998, Pg. 2, 56 words).
Very positive expectations or statements in social context (S5) (+2x weight in net result)	The message contains extremely positive predications about a specific technology or technological breakthroughs with high social impact; underlining the need and importance for a specific technology.	"E-mail, Internet and the cd-rom change the way of communications in society, and with it, perhaps society itself" (NRC Handelsblad, September 18, 1999, Pg. 9, 108 words).
Very negative expectations or statements in technological context (T1) (-2x weight in net result)	Negative superlatives or general disappointment about the respective technology. Vulnerability of the technology may also cause large scale economical or social problems.	"A terrorist organisation that targets just 4% of the world's most important servers and manages to disable these can effectively partition the internet into small communication networks that are no longer able to communicate worldwide … considering the growing economic importance these may become an interesting target" (NRC Handelsblad, July 29, 2000, Pg. 35, 70 words).
Negative expectations or statements in technological context (T2) (-1x weight in net result)	Negative statements or concern about the respective technology.	"Internet is not always faster via ISDN or cable [while] ISDN is much more expensive than an analogue connection" (NRC Handelsblad, December 17, 1998, Pg. 17, 633 words).
Contains both positive and negative elements (T3) (no weight in net result)	A discussion characterised by negative and positive elements. It may include a variety of technological issues but the discourse is followed/ counteracted by more positive statements.	"PTT Telecom wants to offer its customers the possibility to make phone calls via the internet. The company is forced to embrace with extremely cheap and thus threatening technology. However, the quality still has a lot left to be desired"
Positive expectations or statements in technological context (T4) (+1x weight in net result)	Characterised by positive statements where a technological advance has been made. Breakthroughs are absent.	"The Australian concern News Corp, property of media tycoon Rupert Murdoch, is cooperating with the United States company Rockwell Internet in order to develop internet for airlines. "In Flight Network" will be operational at the end of 2001" (NRC Handelsblad, March 7, 2000, Pg. 1, 852 words).
Very positive expectations or statements in technological context (T5) (+2x weight in net result)	Extremely positive indicator which may be related to extremely positive predictions about a specific technology or technology breakthroughs.	-

Light Blue	Article contains implicit evidence for necessitation, expresses a feeling of dependence on the technology, routinisation, profound social embedding et cetera.	-
Dark Blue	Article contains explicit evidence for necessitation, expresses a feeling of dependence on the technology, routinisation, profound social embedding et cetera.	-
Green	Important article, but not possible to classify or very difficult to classify initially. In-depth review required.	-
Yellow	Article contains Implicit expectations.	
Orange	Article contains explicit expectations.	
No Colour (nc)	Contains implicit element but is not thought to have a wider impact or is close to bordering "impersonal". In-depth review may be required in some cases.	
x	Impersonal statement	

Note: Although the above classification of articles in several dimensions will reveal the general trend of the discourse about the respective technologies, there is bound to be a vast number of articles that are not relevant but still make mention of the aforementioned technologies. During the research however, these articles will not be tagged with the system above, but will instead be considered to be "impersonal". Impersonal articles may also simply include a link to the off topic article on an internet website. This is not necessarily relevant for the technology itself, but it gives the reader incentive to use the specific technology in order to find out more about the article. Finally, while these hold some social value, statements about financial performance of ICT firms, M&As, lawsuits against cartel formation or monopolisation are not considered to have a technology related social or technical impact unless they are exceptionally profound.