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A MULTIFACETED DYNAMIC MODEL OF THE DIGITAL DIVIDE

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ABSTRACT

This article criticizes current research on the digital divide as being mainly descriptive, starting from a too simple criterion of access and failing to consider the many origins and consequences of differences in IT access. It presents the outlines of a needed multifaceted theoretical model in which Internet access is seen as dependent on the user's 1) motivation, 2) possession, 3) digital skills and 4) use patterns. Various causes and consequences of differential IT access are being taken into account.

Having access to IT can be seen as only one factor that produces differences in social, cultural and economic outcomes. These outcomes, in turn, are also influenced by the forces that produce differences in IT access in the first place, as part of a larger pattern of feedback loops. Distinguishing direct from indirect effects using this model becomes an important empirical task. Results from previous empirical research, mainly conducted in the Netherlands, are used to illustrate parts of the model and possible theoretical outcomes of future research.

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Concerns about increasing social inequality lie at the heart of the debate on the rise of the information society, but too often these discussions are restricted to simple inequalities in access to new information and communication technologies (IT). This article criticizes current research into the digital divide as being 1) mainly descriptive, 2) starting from a too simple criterion of access and 3) lacking in consideration of the possible consequences of differences in IT access.

This article summarizes conceptual work aimed at modeling the relative influence of IT on social inequality that starts with a multidimensional concept of access (consisting of motivation, possession, digital skills and use) and models both causes and consequences of differences in IT access. In the process, it summarizes and integrates the theoretical-empirical research at the program on IT and Society of the Social and Cultural Planning Office in The Netherlands. Although reviewing and attempting to integrate a variety of previous literature, readers interested in more thorough literature review are encouraged to read DiMaggio et al. (2001; 2003).

1. PROBLEMS WITH CURRENT RESEARCH ON THE DIGITAL DIVIDE

It is usually assumed that PC's and the Internet are transforming our economic, political, social and cultural lives (Castells 2001; Bell 1973). Since these new "key technologies" are regarded as major engines of change, much attention has been devoted to their diffusion, especially to inequalities in the access to these technologies (OECD 2000, 2001; NTIA 1999, 2000, 2002). These studies document dramatic and consistent differences in access across population groups. However, current existing research on so-called digital divide suffers from several shortcomings.

1) Concern with the *simple criterion of access* -- usually in the convenient locale of one's home (Robinson et al. 2003). Most analyses conceive of Internet access as binary -- either someone is an Internet user or is not (Lenhart and Horrigan 2003). This binary nature of the arguments hinders and disregards previous theoretical progress in understanding the influence of communication and processes of social change (Mason and Hacker 2003).

2) Being mainly *descriptive*, focusing on recording the presence or absence of IT and on whether gaps in access and usage are closing or widening. It simply attempts to connect a set of socio-economic characteristics to the possession and use of a PC and to Internet access, but it fails to take into account how these differences arise. At best, multivariate analysis is applied in order to establish which of these characteristics is most important (Robinson et al. 2001), or it proposes more sophisticated methodological tools to measure the closure or widening of the digital divide (Martin 2003).

> 3) Lacking concern about the *consequences* of differential IT access. Although much attention has been given to the influence of IT diffusion on, for example, users' use of time (Robinson 2002), social interactions (Nie and Erbring 2002; Kraut et al. 1998; 2002) and work habits (Steijn 2003), it is hardly ever directed as asking to what extent differences in IT access decrease, reproduce or increase existing social differences.

Thus, this article presents a conceptual model that contains a more elaborate image of access and presents a modeling of both causes and consequences of IT access, using available empirical findings to support various parts of the model.

To overcome problem 1 above, the binary concept of the digital divide is replaced by a multidimensional concept of access to the information society. For IT to be *used* effectively three types of user access are relevant: *motivation*, *possession* and *digital skills* (Van Dijk 1999, Viherä 2000, Marsh 2001, Steyaert 2002; De Haan and Huysmans 2003). Motivation refers to attitudes towards IT: the interest in it, the will to use it and the lack of fear of new technology. Possession refers to the availability of equipment, such as an Internet connection at home (dial-up connection or broadband), including autonomy in access to it, as well as access at work, school or university settings. The third component of digital skills refers to the extent to which potential users are able to handle IT. The consensus that motivation, possession and skills are relevant independent aspects of access has been challenged by the controversy about the relationship between these kinds of access, and two alternative models of access presented by De Haan and Iedema (in press) will be discussed in some detail in Section 1 below in order to conceptually clarify their interrelationships.

To overcome problem 2 about demographic predictors, *resource theory* is introduced to search for the deeper causes of unequal access to IT. The acceptance of IT products, their use and digital skills are studied as the result of choices made by consumers. In their decision-making process potential users are motivated by preferences and confronted with constraints. This theory assumes that the adoption of IT can be explained by differences in constraints between individuals, so that people are constrained in their possession of resources. Differences in this regard result not only from the quantity of these resources, but also from the type of these resources, with a distinction drawn between material, cognitive, social and time resources. This distinction draws on the work of Bourdieu (1984) and (Coleman 1990). In order to stress that competencies to handle information are mental capabilities, they are referred to here under the term "cognitive resources", a concept closer to Coleman's "human capital" than to Bourdieu's "cultural resources". In addition to these types of resources are *time* resources, particularly the amount of free time available to use IT as a leisure activity. The general assumption is that more resourceful people will adopt IT earlier than people with fewer resources (as in Rogers 1995) as discussed further in Section 4.

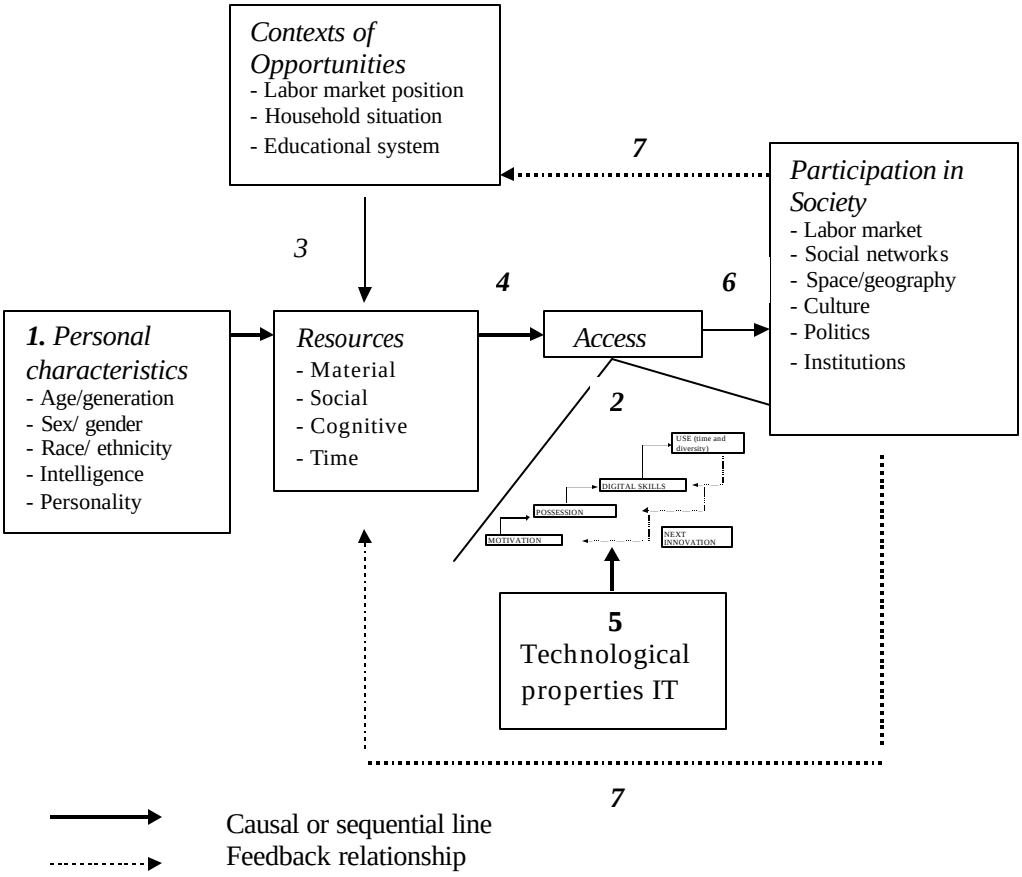
To overcome problem 3 about the social consequences of IT, attention is shifted from differences in access between population groups to behavioral consequences of these inequalities. Ultimately, one should be able to show to what extent differences in access are related to gaining rewards that do not directly result from previously existing differences in resources. The general hypothesis is that people who have better access to IT have a competitive advantage in their quest for these rewards than do people with poor access. These consequences can be studied in many different fields. By way of example, in Section 4 below, focus is restricted to six kinds of participation in society: education (educational level), economic life (quality of labor), social life (relationship networks), child care (social support for raising children), leisure (cultural opportunities) and political participation (online involvement in discussion and decision making). In each of these fields, increasing differences between people and population groups can be studied as a process of accumulation of advantage (AOA), or of increasing gaps between the resource rich and resource poor, an hypothesis further developed in Section 5.

Figure 1 summarizes these arguments. This theoretical model builds on the work of investigators at the University of Twente (Van Dijk 1999; Van Dijk and Hacker 2002) and the Dutch Social and Dutch Cultural Planning Office (SCP) (Van Dijk et al. 2000; De Haan and Rijken 2002; De Haan and Huysmans 2002; De Haan and Iedema in press).

Among the elements of this model that have yet to be introduced is the distinction made between personal characteristics (such as age, sex, ethnicity, intelligence and personality) and the contexts of opportunities which also distinguish these individuals (level of education and income, having a job and other household members). One reason for this distinction is that the household, the school and the work place provide different structural contexts in which people can create or receive the opportunities to use IT and to meet with people who can help solve computer problems. These context opportunities thus involve places where resources can be acquired and applied.

A second reason is that the application of IT may produce outcomes that have feedback relationships to these contexts. On-the-job training and lifelong learning are but two examples of how outcomes influence resources. In Section 2, the relationship between schools and households will be discussed in more detail as contexts were students gain digital skills. More attention will be given to these feedback relations in Section 5, where it is further assumed that personal characteristics are not influenced by feedback relationships.

FIGURE 1: MULTIDIMENSIONAL CONCEPTUAL MODEL FOR EXPLAINING INEQUALITIES IN THE INFORMATION SOCIETY (NUMBERS REFER TO PROPOSITIONS IN THE TEXT)



Technological properties of IT can influence (the rate of) diffusion. IT innovations are classified as relatively complex consumer goods with high prices. Besides complexity and price, four other characteristics are distinguished, following Rogers (1995: p.207 ff.): compatibility, testability, visibility and the relative benefit. The rate of diffusion of different products offers some information on the influence of product characteristics. For example, the spread of color television was more rapid than that of the VCR, which in turn penetrated the community faster than the PC. These differences cannot be attributed entirely to differences in price levels: color TV was also an expensive product in the 1970s. Other product characteristics can play an important role here. The relative benefit of color television compared with black and white sets was obvious for large sections of society. The user-unfriendliness of the PC, by contrast, contributes to its relatively slow spread.

In sum, the following 7 theoretical propositions underlie the model referred to by the numbers 1-7 indicated in Figure 1):

1) Personal characteristics enhance probability of IT access (the digital divide).

2) Access consists of motivation, possession, digital skills and use of IT.

3) Structural contexts of opportunities produce an unequal distribution of resources.

4) Unequal distribution of resources causes unequal access to digital technologies.

5) Inequalities in IT access also depend on technological properties.

6) Unequal access to IT produces increasing social inequalities through a process of accumulation of advantage.

7) Growing inequality in societal participation reinforces the unequal distributions of resources and produces new differences between opportunity structures in which these resources are gained.

Together these propositions constitute an overarching multifaceted model for analyzing social inequalities in the information society.

Each of the following sections can be considered as a building block of this model. Section 2 elaborates on proposition 2 by contrasting two competing models of access. In Section 3's elaboration of proposition 3, the household, the school and the work place are introduced as structural contexts of opportunities. Access can also be found in libraries, media centers or cafes. However, data from The Netherlands show that Internet is used far less often at these locations that in the household, the school and the workplace. In order to simplify the model, access in libraries, Internet cafes and the like has not been included.

Control over different types of resources is described as a mechanism to explain differences in access between individuals in Section 4, which elaborates on proposition 4. The accumulation of advantage (AOA) hypothesis is presented to account for increasing social differences in the information society as a result of differences in access. Section 5 elaborates on proposition 6, while the final Section 6 concludes with suggestions for future research.

2. TWO COMPETING MODELS OF ACCESS

Much of the discussion on the digital divide has been based on *possession* and *use* of a PC and an Internet connection. Less but still substantial attention has been paid to *digital skills* or competence and to *motivation*. Here a multidimensional concept of access to the information society is introduced, consisting of motivation, possession, digital skills and use (proposition 2 in Figure 1). A positive attitude towards digital technology (motivation) is becoming increasingly relevant to properly functioning in an

information and network society. Lack of interest can be considered as a barrier to reaching scarce rewards (Van Dijk and Hacker 2002) or to active participation in communicational exchange (Marsh 2001). A negative attitude might be so strong as to lead to "cyber-phobia" or a fear of computers that prevents people from using them altogether. Mental barriers may restrict people from adopting new technology. The degree to which people are willing to adopt new technology has also been called 'mental accessibility' (Van Dijk 1999).

The *possession* of IT, also referred to as physical access, is the second aspect of access to the information society. Owning a PC and being connected to the Internet are crucial factors for the retrieval and processing of digital information and for the use of communicational opportunities. The speed and possibilities of use also depend on the kind of Internet connection: narrowband (dial-up connection) or broadband (cable, ADSL or fiber-optic). Even possession of IT is not binary, but rather a digital spectrum in which access is intermittent for many users, nearby for some users and a remote possibility for others (Lenhart and Horrigan 2003). Physical access need not be restricted to PC ownership and Internet connection at home but can also be realized at work or at school. Some researchers, such as Steyaert (2002), widen physical access to universal access, including access in libraries, Internet cafés and information kiosks. In this way everybody potentially has access, and access can no longer be considered as a barrier to participation in the information society. Here, one refers to physical access as having a personal computer and a network connection at home, at school or at work.

Changes in society demand new *competences and skills*. Because of the growing amount of information on the Internet and people's increasing dependence on information, the importance of digital skills for participation in several social areas such as labor, education and social contacts has also increased (cf. Steyaert 2002). Marsh (2001) stresses the importance of being able to use new media in order to actively participate in communication exchange. Digital skills constitute the third element of access. These skills refer to the use of new media in general, but often a focus exists on Web skills. Finding information on the Web is often a complex search process. People search the Web for content in myriad ways, and there is large variance in whether people are able to find various types of information and in how long they take to do so (Hargittai 2002; 2003).

The *use* of IT is the fourth and last element of access and is distinguished here in the amount of time people spend using a PC and the number of different applications they use it for (diversity).

There is emerging consensus that motivation, physical access, competence and use are key factors for new modes of behavior in the information society. Multidimensional access is relevant for participation in decision making in a democratic society (Hacker and Van Dijk 2000; Marsh 2001), in community life and in civic engagement (Steyaert 2002; Vih erä 2003), but is also important for labor market participation (Steijn 2003), e-commerce (Fructuoso van der Veen and De Haan 2003) and other forms of participation. This consensus about the relevance of these elements notwithstanding, there is controversy about the relationship between them.

A distinction is made between a *hierarchical model of access* and a *crosscutting circle model of access* (De Haan and Iedema (in press)).

A *hierarchical model of access* assumes that motivation is basic to physical access (possession), which in turn is a necessary precondition for competence. This view is defended most strongly by Van Dijk (1999). Van Dijk and Hacker (2002) speak of 'successive kinds of access': possession builds on motivation and skills build on possession. Steyaert (2002) thinks along similar lines, although he leaves out motivation and presents physical access (possession), instrumental digital skills, usage skills and information skills as additional elements.

In a *crosscutting circle model of access* the three elements of access are considered to be equally important and relatively independent of each other compared to the hierarchical model. Viherä (2000) and Marsh (2001) assume that digital skills (competence) can also be acquired without possessing IT and that neither skills nor possession presuppose motivation. They stress the interconnectedness of the three types of access. At the heart of their model lies communicational capability which combines *access*, *motivation* and *competence*. If one of these elements is lacking in social exchanges – including digital exchanges – communication cannot take place. They assume that citizens need these communication capabilities to be able to be full members of the information society. The forms of access can influence each other. For example, good access and competence can increase motivation. But if citizens are motivated to influence the decision-making process, they will find or acquire suitable tools and means to participate, such as information on the Internet.

De Haan and Iedema (in press) measured these models in order to establish which model most closely matches reality. To test whether the hierarchical model or the crosscutting circle model was more in line with the data, they used structural equation modeling (SEM), with the AMOS program. When the influence of the predictors of motivation, possession and digital skills were adjusted for each other, skill emerged as virtually the only predictor that influenced IT use. IT access at work or at school had some influence on IT use as well, but only on the amount of time used and not on the diversity of use. Thus the claim of the crosscutting circle model that each type of access has an independent influence on IT use was not supported.

There was more support for the hierarchical model of access: motivation influences possession, possession influences skill, and skill influences IT use. Motivation has influential path coefficients to the possession variables. In this model it is not necessary to include direct paths from motivation to IT use for the model to fit adequately. The possession variables, in turn, were strongly related to skill, as expected from the model. Finally, skill shows very large path coefficients to the IT use variables, as expected.

Further support for the hierarchical model can be found in the indirect paths of effects. Motivation is not irrelevant for the use of IT. In fact, motivation influences IT use through possession and skills. The indirect paths from possession to use are also significant. A further inspection of the

assumptions of causality by testing alternative models did not result in a better model. In sum, De Haan and Iedema (in press) concluded that the hierarchical model of access is a better representation of reality than the crosscutting circle model. Given the centrality of digital skills in the hierarchical model, it is important to know were these skills are acquired. The next section discusses the social contexts in which this is done.

The multidimensional concept of access is quite complex, which makes it difficult to estimate the effects of differences in access. Reducing this complexity will often be necessary. The analysis of the models of access indicates that it is best to use digital skill as an indicator if a single indicator of access needs to be taken into account. The outcomes from testing the two models also hold social policy implications, since they indicate where to start if people are not on line.

3. STRUCTURAL CONTEXTS: OPPORTUNITY STRUCTURES AND NETWORK COMPOSITION

The household, the school and the work place are considered to be structural contexts of opportunities for gaining several kinds of resources and subsequently access to IT, according to proposition 3 in Figure 1. Households are divided by unequal incomes (a material resource) which create divergent opportunities for buying IT equipment. Households also differ in composition. Other household members (social resources) can be of assistance in solving IT problems. For example, for children it matters whether their parents can be of help. Schools differ in IT facilities, IT personnel and the extent to which IT is integrated into the school curriculum.

Knowledge workers are becoming increasingly dependent on digital technologies for their work. Being employed strongly stimulates the access to IT. Students and workers are involved in at least two of these three contexts. Here the first focus is on the relative importance of the school and the home for gaining digital skills among students. With the increasing diffusion of equipment, digital skills turn out to be the most central aspect of IT access.

Comparing the opportunity structures of students: Today's younger generations grow up surrounded by digital media. In particular at home, though increasingly at school as well, they have access to a computer, the Internet and digital technologies, such as video games and CD-ROMs. Not all young people are equally skilled in the use of IT, however. The growing amount of information, the continuous reinvestment of acquired information and the growing influence of IT on the daily lives of ordinary people mean that possession of computer skills has today become more important for successful and meaningful participation in society. Although little empirical evidence is available, these digital skills are assumed to play a key role in the distribution of opportunities on the labor market, the distribution of scarce goods and the amount of social participation (as hypothesized in Steyaert and De Haan 2001).

Schools have traditionally played a key role in imparting skills such as language and arithmetic ability, so it is reasonable to assume it also applies today for the imparting of digital skills. A great deal has been done in initial education in recent years to integrate digital technology into teaching. More and more schools have access to more and more PCs, which are more and more frequently connected to the Internet. The use of computers within and outside lessons is also gradually increasing; as teachers are being given computer training and the level and quality of IT support at schools is improving. Nonetheless, it may well be the case that there is more IT knowledge among the students than among their teachers.

The social/educational context in which young people acquire computer skills can differ, as well as the extent to which there are differences between people from different social backgrounds and between students in schools with divergent IT facilities. What role does the school play in students' gaining digital skills and does the teaching of IT skills offer compensation to pupils from disadvantaged groups? In order to answers these questions De Haan and Huysmans (2002a) used data from 66 Dutch high schools with an average of 21 pupils per class. A total of 1,213 pupils completed an in-class questionnaire about IT and the school in the Spring of 2001, with a response rate of 74%. IT coordinators at each school were asked about IT facilities at the school, IT education programs, the computer skills of teachers and the presence of specialist IT staff.

Three hypotheses: In order to account for differences in digital skills between high school students three possible explanations were presented (De Haan and Huysmans 2002a), called the *instruction* hypothesis, the *selection* hypothesis and the *social background* hypothesis.

According to the *instruction* hypothesis, these differences can be attributed to differences in school IT facilities and the extent and quality of the teaching about and with IT. Although there are considerable differences between schools, the influence of the school per se on the acquiring of digital skills in fact proved to be very limited. Neither the PC infrastructure nor PC-based teaching at the school appeared to contribute to the development of PC skills by pupils. The only school characteristic that seemed to have any influence was the presence of a helpdesk, a finding that also fits with the statement by pupils that they learned most from self experimentation. Pupils do seem to learn more if support is at hand when problems occur.

According to the second, *selection*, hypothesis differences in computer skills are mainly related to general intellectual skills. Since schools select students on the basis of the general skills, so the differences in computer skills between pupils from different school types are purportedly attributable to their divergent general intellectual capabilities. However, no correlation was found between differences in computer skills and general intellectual skills, after controlling for the influence of the home environment. The fact that pupils at senior general secondary schools (havo) and pre-university schools (vwo) generally have better computer skills is thus not the direct result of educational selection based on general intellectual capacity.

Instead, testing of the next hypothesis indicates that these differences must be attributed to differences in the home situation.

This third hypothesis, the *social background*, hypothesis offered the best explanation for differences in digital skills, in that differences in digital skills between pupils related to the home setting in which they grew up. The presence of PCs in the household in which pupils grow up proved to be a particularly strong indicator in this study: the number of PCs present in the home, the presence of an Internet connection, the possession by pupils of a PC in their own room and the number of years' experience in using a PC. In contrast, the characteristics of the parents -- their average education level, their PC experience gained at work and the presence of a father in the household -- did not make any additional contribution to the PC skills of their children. They did, however, help to explain the degree to which the household possesses the PC infrastructure which is evidently so important for young people. Young people who come into contact with a PC at an early age, who have three or more PCs in the home of which at least one offers Internet access, and who have one of those PCs in their own room, are significantly more skillful with computers than their peers who only came into contact with PCs later in life or who had no computer facilities in their home situation. These characteristics overshadow the efforts made by schools and teachers to increase the PC skills of their pupils. The study makes clear that the differences in digital skills between pupils can primarily be traced to the home setting.

Compensation or cumulation? While generally speaking the school offers no added value in terms of the imparting of computer skills, this may not be the case for those few pupils who have no access to a computer or the Internet at home. Here, schools may compensate for their disadvantaged home situation. On the other hand, it is also possible that differences in access at school actually reinforce differences at home. In that case relatively small differences in the home situation could lead to greater differences in school careers, and possibly in later working life. If the influences of digital socialization at home and at school reinforce each other, this leads to an accumulation of advantages. The two mutually exclusive hypotheses on the interdependence of the influence of parental background and education are referred to here as the *compensation* hypothesis and the *cumulation* hypothesis.

In The Netherlands, no clear indications were found that schools compensated for disadvantages in computer skills (De Haan and Huysmans 2002a). The five groups at a relative disadvantage -- girls, non-Western ethnic minorities, pupils who came into contact with PCs relatively late, pupils without a PC at home and pupils in grade 3 of pre-vocational secondary schools -- appeared not to benefit to a significantly higher degree from IT teaching. In the first three cases the effects did operate in the presumed direction of compensation; in the latter two, however, they operated in the opposite direction, towards cumulation. Pupils in grade 3 of pre-vocational secondary schools and pupils with no PC at home thus derived less rather than more benefit from IT teaching, even though these effects are

not statistically significant. The conclusion is that no clear indications were found for either compensation or cumulation effects. This is in line with the earlier finding that IT education at school has virtually no influence on the PC skills of pupils. To what extent these results also hold for countries other than The Netherlands is not known.

The differences in computer skills, which are gained largely by learning through experimentation at home, are hardly influenced thereafter by secondary education. Only a small portion of the differences found between pupils can be attributed to schools (or school classes). Better facilities (more advanced equipment, computer rooms, Internet connections), better support (IT coordinators and other IT staff), planned activities (IT policy plan, attainment targets for pupils) or better IT education in the lessons did not lead to greater differences in computer skills between pupils. The information society appears to be less susceptible to educational influence than was hoped or expected. Pupils enter secondary school with quite a few skills and the skills of younger students are likely to be greater as more of them learning to use a computer by experimenting at home.

The elderly: During professional careers digital skills will be used and further developed, especially as the use of a PC at the workplace enhances attitudes towards having and using a PC at home (De Haan 2001). However, at present the differences between the young and old remain fairly wide, particularly as those over age 65 never have had the opportunity to acquaint themselves with IT at school, and lag behind in their ownership and use of IT, as well as their digital skills.

Older people may thus be regarded as "laggards" in the diffusion process (as in Rogers 1995). Since they also view IT less positively than young people, they will first need to overcome psychological barriers before starting to use the computer and its online possibilities. Like young people, older people also learn most by trying things out themselves on the computer. One age difference is that older people make greater use of formal learning pathways, while young people follow more informal paths (De Haan 2001). Older people more frequently state that they take computer courses and consult computer handbooks as learning sources.

In the future, as more older people acquire a computer, availability of the PC may be an important stimulus for their acquisition of digital skills as well, so that the ongoing distribution of computers will also contribute towards greater skills among older people. Among people above age 50 in particular, PC experience gained at work is the most important factor determining whether older people also have a computer at home (Van Kesteren and De Haan 2000) -- having about the same influence on the presence of a PC in the home as a person's education level (De Haan 2001).

4. RESOURCE THEORY: THE IMPACT OF DIFFERENT TYPES OF RESOURCES

Explaining differences in the possession and use of modern IT facilities as well as differences in digital skills can be based on studies of the diffusion of innovations, social network analysis and research on information

processing theory. According to Rogers' (1995) diffusion of innovations model, the decision to accept a (new technology) innovation is dependent on different characteristics of products, as well as on the personal, social and economic characteristics of consumers and on their channels of information that provide relevant knowledge on new products. The focus in the theoretical framework presented here is on consumer characteristics and the way these characteristics constrain their choices. People are constrained by their possession of resources: material, cognitive and social resources (as in Coleman 1990).

Material resources: Material resources include the financial budget of households, but because in some senses time is money, the available free-time hours also fall under this category (time resources). Studies on consumer behavior have shown that income and the costs of IT products affect the purchase of these products, with people with higher incomes spending a relatively larger part of their financial budget on luxury consumer goods (Linder 1971), including IT products (Van Dijk et al. 2000). This relationship will be stronger the higher the prices of the goods, which applies both to purchases of new goods and to replacements of old ones.

Available free time also provides an incentive to buy and use IT products. Amount of leisure time affects media consumption among retired people, who on average have most leisure time and who are the greatest consumers of television programs (Rubin and Rubin 1981; Knulst and Kalmijn 1988). De Haan and Huysmans (2002b) found that Internet users in the Netherlands have on average three hours more leisure time than nonusers after controlling for background characteristics. In contrast, people with paid jobs can be expected to use Internet during working hours.

Cognitive resources: Cognitive resources, also called human capital (Coleman 1990), can be defined as the ability to deal with symbols and information. Three types of cognitive resources are distinguished: *literacy*, *numeracy* and *informacy*. Which cognitive resources are primarily important? For a long time the ability to process written information was the most important skill for communication and processing information. These classic skills are called *literacy*, meaning the ability to use information from books, newspapers and magazines, with the parallel ability to handle quantitative information called "numeracy" or quantitative literacy (OECD 1995). Another type of skill becoming increasingly important is "informacy", or the ability to handle information that becomes available through digital technologies.

Education is often used as an indicator of informacy, because the school is the most important location were these cognitive resources are acquired, as well as for literacy, which is acquired earlier in one's educational career. More attention is thus paid to informacy in higher forms of education; cognitive resources (literacy, numeracy and informacy) have been documented to be strongly related to the educational level people reach (OECD 1997).

Given the importance of education for informacy, it is also relevant to know in which time era people went to school, with persons born after 1960 having a far greater chance to acquaint themselves with IT during their educational career. The generation born after 1960 has already been called the 'technique generation' (Sackmann and Weihmann 1994) and the 'net generation' (Tapscott 1998). Among other reasons why older people might use new media less often than young people are that they less often pursued higher levels of education, left the labor market before they could learn to work with computers, and their decreased physical, sensory and cognitive skills -- as well as decreased interest in new products and life styles (OECD 1997; Van Rijsselt en Weijers 1997; Freudenthal 1999). (There may also be a distinction between men and women, in that women are less educated, have participated less often in the labor market and may have acquired less experience with technology during their gender-specific socialization (Rijken 1999)).

Social resources: Social resources consist of the access which people have to other people's sources of help and training (Flap 1999; Robinson, Dimaggio and Hargittai 2003). In the field of IT these consist of access to people in one's social settings who themselves possess new IT products, the digital skills which can be addressed in this way, and the degree to which these persons are in a position to provide information on IT. People will be more likely to buy and use new IT if more persons in their social networks can provide information on IT and if they can and are willing to give advice.

Friends, acquaintances and colleagues can also reduce the uncertainties that often accompany the purchase of new consumer goods (Bettman 1979). Uncertainty may relate not only to the cost and quality of a product but also to its acceptance in one's social community. Products that can be tested and that fit within existing norms and values are more "visible" and bring less uncertainty. Social contacts thus not only provide information, but they can also be a source of social approval and social distinction. In general, people tend to adopt the behaviors that give them greater affirmation from the group in which they live and especially from the people they consider to be important (Burt 1987). Positive feedback on the acquisition of IT can provide them with social well-being. Through the possession of luxury goods they can also distinguish themselves from others and give them higher status. More than the cultural elite, the economic elite will try to attain more status via material ownership (cf. Bourdieu 1984).

To what extent can different resources explain the digital divide? In other words, to what extent can they explain differences in possession, use and digital skills, say between men and women and between different educational or different age groups? Hypotheses derived from resource theory were tested with data drawn from the Use of New Communication Resources (UNCR) Survey, a national survey carried out in The Netherlands in the Fall of 1998 (n= 2538 with a 43% response rate); survey details are provided in Van Dijk et al. (2000) and in De Haan and Rijken (2002). OLS multivariate analyses were used to estimate the effects of the different types

of resources, which were added step-by-step to equations in which the background characteristics were already present.

Cognitive resources were found to be largely responsible for differences in use and in digital skills between different educational groups. The more educated also more frequently have the various IT products at home, but these differences cannot be attributed solely to their cognitive skills but to differences in use between different age groups.

To some extent the difference in IT possession and IT use between those in work and the unemployed can be attributed to divergent social resources. The effect of income on IT possession, and on IT use, is also reduced when allowance is made for the difference in social resources. The same applies for the effect of education levels on IT possession. Higher status groups evidently have access to well-informed networks so that, irrespective of their own skills, they are more likely to acquire IT products. Material resources influence only the possession of IT facilities, not their use or skills.

The explanation based on the different types of resources was not adequate for all segments of the population. This applies in particular for the large differences by gender. In the area of digital skills, the differences between men and women were hardly reduced if allowance is made for divergent access to resources. With regard to possession and use of IT, more than half the gender differences remained unexplained. The explanation for these differences must therefore be sought in factors other than the resources measured.

The differences between age groups in all three domains also largely remained after control for the influence of resources. Lack of experience with modern technology on the labor market played an important role here, but a wary attitude towards unknown products and few opportunities for use could also be important. In this research project, the influence of schools and the work place as contexts of opportunities were not fully taken into account.

5. ACCUMULATION OF ADVANTAGE: MATTHEW EFFECTS

If new technology contributes to growing inequalities in the information society, the influence of access to IT must be in addition to existing sources of inequality, such as inherited wealth, social networks and educational and occupational success (as noted in proposition 6 of Figure 1). In other words, in the struggle for scarce rewards IT access must be seen as a new kind of resource in addition to social, material and cognitive resources. These digital resources must be able to produce advantages in many different social fields. As these digital resources are concentrated in the hands of those that are already rich in terms of access to other kinds of resources, alignment can be sought in the accumulation of advantage (AOA) hypothesis for explaining increasing inequality.

This AOA hypothesis originates from the sociology of science research, in which Merton (1973) introduced the "Matthew effect" to explain differences in performance between scientists. Zuckerman (1977: p.59/60) describes the AOA-hypothesis as follows:

> Advantage in science, as in other occupational spheres, accumulates when certain individuals or groups repeatedly receive resources and rewards that enrich the recipients at an accelerating rate and conversely impoverish (relatively) the nonrecipients. Whatever the criteria for allocating resources and rewards, whether ascribed or meritocratic, the process contributes to elite formation and ultimately produces sharply graded systems of stratification.

This hypothesis can also be applied outside the area of science. The accumulation of resources can lead to highly stratified outcomes in many different fields of society. Unequal access to digital resources may have behavioral consequences that may lead to increasing inequality. If this assertion would hold up with empirical evidence, people who have better access to IT have a competitive advantage in their quest for scarce rewards than people with poor access. No research appears to have addressed the question of accumulative advantage of digital resources, *and* used a model that takes into account the influence of other factors, *and* used a methodology that is appropriate for distinguishing the influence of IT from these other factors. This is a challenge for empirical research in the future. The empirical work that is discussed below does not meet these requirements, but at least points in the direction that a process of accumulation that might be at work.

Accumulation of advantage through acquiring digital resources is a process rather a specific event. Access to IT is not binary, but acquired step-by-step at the levels of motivation, possession, skills and use. As Cole and Singer (1991) argue, differences between people do not arise from aggregate or specific differences in talent, nor from a particular decisive event, but rather from a "sequence of events". Outcomes of earlier events influence subsequent events by changing the opportunity structure. The opportunity structure includes access to several kinds of resources. Thus, there are feedback relationships from what in Figure 1 is called participation in society to the interaction system in households, schools and workplaces and to the different kind of resources (cf. Boudon 1981).

Existing research on IT and social inequality has so far not dealt with modeling feedback relationships. Neither has it included the full set of factors as are presented in Figure 1. However there is some research available that at least includes some of these factors and points us in the direction that processes of accumulation might be at work. Without claiming to cover all research, some research will be presented here that points to the relevance of studying the accumulation at advantage in more detail.

Ideally, cumulative advantage exists when an initial advantage (for example, higher education) bestows a secondary advantage (such as high levels of digital skills), which has an independent effect on some outcome measure (like earnings) net of the initial advantage. Most of the research presented below does not satisfy the methodological needs that seem required to draw valid conclusions on changes in inequality as a result of IT access. First of all, correlation is not an appropriate tool for this purpose.

Testing the AOA-hypothesis requires multivariate analysis. Using OLS regression analyses this would require a significant effect of the secondary advantage on the outcome measure, while controlling for the relevant initial advantages. An even stronger confirmation of the hypothesis would be evidenced by a significant interaction effect between the initial and the secondary advantage. OLS regression analysis would be preferred over structural equation modeling (LISREL), in order to distinguish the direct effect from the initial advantage on the outcome measure from the indirect effect from the initial advantage through the secondary advantage on the outcome measure.

Some results from empirical research by way of example: In the field of education one might wonder if mastering IT is related to educational success. The PC has found it way to the classroom, and as PC use is also integrated more and more into the school curriculum, students who are more at ease and skillful with IT may have an advantage. Borking (1999) applies multivariate analyses and shows that children with more digital resources (calling these resources 'digital capital') reached higher levels of education. Although the effect was small, it shows that these resources have an additional significant effect besides several other forms of capital (4% of a child's educational level can be explained through his or her digital capital). Borking (1999: p.86) concludes that "…children who are born in higher economic families have a greater chance of being exposed to parents' digital capital, which leads to educational use of the computer by the child and this leads to a higher education level". This certainly implies that a process of accumulation of advantage is at work.

In the labor market it would be interesting to know to what extent IT improves or worsens the quality of work, or to what extent more digital resources contribute to higher rewards such as income and chances of employment. Research on the quality of work shows that the higher occupational classes more often work in non-Frederick Taylor type labor systems and more often benefit from human resource management (HRM) based policy than the lower classes. This organization of labor using HRM in combination with PC-use turns out to have positive effects, such as more autonomy, more flexibility and less risk for stress (Steijn 2003). Thus, those who already have an attractive labor market position benefit more from the diffusion of IT that those with less attractive jobs. This points to accumulation of advantage at the workplace. Whether control over digital resources improves labor market chances or leads to higher incomes is not yet known.

Empirical support for the accumulation of advantage hypotheses can also be found in the field of social contacts. Kraut et al. (1998: 58) present a 'rich get richer' model which predicts that those who are highly sociable and have existing social support will get more social benefits from using the Internet. Thus, "unto every one that hath shall be given", as Matthew (25: p.29) put it. Kraut et al (1998: 67) found that more social resources amplified the benefits that people got from using the Internet on several dependent variables. Among extraverts, using the Internet was associated with

increases in community involvement and self-esteem and declines in loneliness, negative affect, and time pressure; it was associated with the reverse for introverts. Similarly, among people with more rather than less social support, using the Internet was associated with more family communication. They conclude that those who are already effective in using social resources in the world are likely to be well positioned to take advantage of a powerful new technology like the Internet. Haythornthwaite (2001) presents a similar 'rich get richer' model: particular demographic features interact with the use of Internet and enhance existing tendencies with respect to social cohesion. However, there is also evidence that people's interaction online supplements their face-to-face and telephone communication, without increasing or decreasing it (Wellman et al. 2001).

Mothers with preschool children may benefit from using the Internet by exchanging childcare information. Miyata (2002) found that mothers who posted a message in a supportive online community receive more social support from online weak ties in addition to that from strong ties in real life, resulting in increased self esteem and decreased depression than those in the non-posting group, those who never posted any message. As mothers who have existing social support get more support from using the Internet leads Miyata to speak of a manifestation of the Matthew effect.

Spending leisure is based to large extent on information on what to do and where to go. People with higher incomes and higher educational levels use more different kinds of media to inform themselves about a large variety of subjects among which many leisure activities. Also each separate medium (newspapers, journals, books, television, radio and Internet) is used more often as income and educational level increases. In 2000 Internet was an additional source of information that at the time in the Netherlands was used to a far lesser extent than especially newspapers and television (de Haan and Huysmans 2002b). However, use of Internet is on the rise, which might increase the knowledge gap between information rich and the information poor (Robinson 1968; Tichenor et al. 1970; Robinson and Levy 1986). This in turn may affect the spending of leisure time as the information rich are already active in a larger variety of leisure fields than the information poor (Robinson and Godbey 1999). Whether the information rich benefit more in spending leisure with the Internet as an additional source of information than information poor has not yet been established.

What makes democracy tick? Surely the participation of the majority of the population in the democratic process makes a difference. However the percentage of voters show a declining trend. On the other hand, participation in the digital democracy is on the rise (Hacker and Van Dijk 2002). But research in a Dutch municipality shows that those who are active on the Internet in e-debates with local politicians are also involved in other forms of political participation (Van Os and Jankowski 2004). Often these politically active people are higher educated and more wealthy than the non-participants. The new opportunity of participating might give them additional influence in the decision-making process. The increased involvement of a restricted set of people may give them benefits that others

lack. In this way the political power may become based on the interest of fewer but more engaged people.

All of these six examples show that a process of accumulation of advantage is or at least might be at work. Mostly the examples show that access to IT adds on to other resources and thus favors those who are already relatively well off. Does this mean that existing social differences are reproduced or that these are enlarged? Accumulation suggests that these differences are becoming larger, that divides are deepening. However, mostly the analyses on which the conclusions are based involve only a limited set of variables. Furthermore, the selection of research examples was selective, as this article is not intended as a complete literature review. Only research with significant positive results is reported. Drawing empirically-grounded conclusions is not intended here. The examples are merely presented as to illustrate possible relationships. The main goal of this article is to present a theoretical model that may guide future research. It gives directions about the factors that cause differences in IT access and how these are related to consequences. Thereby it also points to relevant statistical controls that are needed in order to draw conclusions about Internet as a cause of increasing inequality in the information society. In the next section some direction for future research are formulated.

6. CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

In this article a theoretical model is presented which includes a multidimensional concept of IT access and a specification of both causes and consequences of IT access.

In order to overcome the binary concept of the digital divide a multidimensional concept of access to the information society is introduced. Four types of access are relevant: motivation, possession, digital skills and use. These types of access have a hierarchical relationship: possession builds on motivation, digital skills build on possession and use builds on skills.

Moving beyond basic descriptive research resource theory is introduced to search for the deeper causes of unequal access to IT. Differences in the acceptance of IT products, their use and digital skills are largely based on differences in resources between people. Material, cognitive and social resources can explain a large part of the differences in IT access between population groups.

At the heart of inequality in the information society lies the question of differential behavioral consequences of inequalities in IT access. Differences in access are assumed to be related to divergent opportunities for gaining scarce rewards. In this way access to IT becomes a new type of resource that influences the distribution of life chances. People who have better access to IT have a competitive advantage in their quest for these rewards than people with poor access. This process of accumulation of advantage has been illustrated in Section 5 by examples from six kinds of participation in society.

In order to properly investigate increases in social inequality datasets are needed that contain information about all the variables in the theoretical

model visualized in Figure 1. Parts of the model have already been investigated and the outcomes have been summarized in this article. However, none of the existing datasets contain all the information that would be needed to test the hypotheses of increasing inequality in a wide variety of fields. Therefore new data need to be collected. These datasets need to include information about background characteristics, different types of resources, the opportunity structures in which these are acquired and applied, the four types of access and indicators for participation in society. Multivariate analyses and structural equation modeling are needed to model the effects and include the relevant statistical controls. It is hoped that the conceptual model presented here will contribute to progress in the research on inequality in the information society.

REFERENCES

Bell, D. 1973. *The Coming of Post-industrial Society*. New York: Basic Books.

Bettman, J.R. 1979. *An Information Processing Theory of Consumer Choice*. Reading MA: Addison-Wesley.

Borking, H. 1999. *Digital Capital: The Influence of Digital Resources on Children's Educational Career*. MA thesis Utrecht University.

Boudon, R. .1981 *The Logic of Social Action*. London: Routledge & Kegan Paul.

Bourdieu, P. 1984 *Distinction, a Social Critique of the Judgement of Taste*. London/New York: Routledge & Kegan Paul.

Burt, R. 1987 Social Contagation and Innovation: Cohesion versus Structural Equivalence. *American Journal of Sociology*, 92, pp. 1287-1335.

Castells, Manuel 2001 The Internet Galaxy; Reflections on the Internet, Business and Society, Oxford: Oxford University Press.

Cole, J.R. and B. Singer 1991 A Theory of Limited Differences; Explaining the Productivity Puzzle in Science. In: Zuckerman, H., J.R. Cole and J.T. Bruer, *The Outer Circle; Woman in the Scientific Community*, W.W. Norton & Co, New York, London.

Coleman, J.S. 1990. *Foundations of Social Theory*. Cambridge: The Belknap Press.

De Haan, J. 2001. IT Use. In: M. de Klerk, *Report on the Elderly in the Netherlands 2001*, Den Haag: SCP, 213-231.

De Haan, J. 2003. IT and Social Inequality in the Netherlands, *IT &Society*, 14, p.27-45.

De Haan, J. and F. Huysmans 2002a *Van Huis uit Digitaal*; Verwerving van Digitale Vaardigheden Tussen Thuismilieu en School. [Digital Life Starts at Home; the Aquisition of Digital Skills between the Home and School]. Den Haag: SCP.

De Haan, J. and F. Huysmans 2002b *E-cultuur: een Empirische Verkenning* [eCulture; an Empirical Approach]. Den Haag: SCP.

De Haan, J. and F. Huysmans 2002c. 'Differences in Time Use between Internet Users and Non-users in the Netherlands'. *IT and Society* 1 2, p.67-85.

De Haan, J. and F. Huysmans 2003 Revolution or eVolution, an Empirical Approach to eCulture. In: D. Dodd, eCulture: *The European Perspective*: Cultural Policy – Knowledge Industries – Information Lag. Conference Reader Zagreb, Croatia 24-27 April 2003. http://www.culturelink.org/conf/ecult/ecultread.html

De Haan, J. and J. Iedema, in press. Models of Access to the Information Society, to be published in *New Media and Society* ,

De Haan, J. and S. Rijken 2002 The Digital Divide in the Netherlands: The Influence of Material, Cognitive and Social Resources on the Possession and Use of ITs, *Electronic Journal of Communication*, vol. 12, no. 1&2.

DiMaggio, P., E. Hargittai, W.R. Neumann en J.P. Robinson 2001. Social Implications of the Internet. In: *Annual Review of Sociology*, 27, p. 307-336.

DiMaggio, P., E. Hargittai, C. Celeste and S. Shafer 2003 From Unequal Access to Differentiated Use: a Literature Review and Agenda for Research on Digital Inequality, Princeton University Center for Arts and Cultural Policy Studies, Working Paper #29, Fall 2003, http://www.princeton.edu/~artspol/workpap29.html.

Flap, H. 1999. 'Creation and Returns of Social Capital; a New Research Program.' In: *The Tocqueville Revue/La Revue Tocqueville* 20 1, p. 5-25.

Freudental, A. 1999. *The Design of Home Appliances for Young and Old Consumers*, PhD thesis TU Delft.

Fructuoso van der Veen, V. and J. de Haan 2002, E-commerce. In: J. de Haan and J. Steyaert, *Jaarboek IT en Samenleving 2003* [Yearbook IT and Society 2003], Amsterdam: Boom, p.133-151.

Hacker, K. and Van Dijk, J. eds. 2000 *Digital Democracy, Issues of Theory and Practice*, London, Thousand Oaks, New Delhi: Sage.

Hargittai, E. 2002 Beyond Logs and Surveys: In-Depth Measures of People's Web Use Skills. *Journal of the American Society for Information Science and Technology*. 5314:1239-1244.

Hargittai, E. 2003 Informed Web Surfing: The Social Context of User Sophistication. In: P. Howard and S. Jones, *The Internet and American Life*, eds Sage Publications.

Haythornthwaite, C. 2001 The Internet in Everyday Life. *American Behavioral Scientist*, 45 3, p.363-382.

Knulst, W. and Kalmijn, M. 1988. *Van Woord naar Beeld?* [From Word to Image]. Alphen aan den Rijn: Samson.

Kraut, R., Lundmark, V., Patterson, M., Kiesler, S., Mukopadhyay, T., en Scherlis, W. 1998. Internet Paradox: A Social Technology that Reduces Social Involvement and Well-being? *American Psychologist*, *53* 9 p. 1017-1031.

Kraut, R., Kiesler, S., Boneva, B., Cummings, J., Helgeson, V., and Crawford, A. 2002. Internet Paradox Revisited. *Journal of Social Issues*. 58 1, p. 49-74.

Lenhart, A. and J.B. Horrigan. 2003. Re-Visualizing the Digital Divide as a Digital Spectrum, *IT&Society*, 15, p.23-39.

Linder, S.B. 1971. *The Harried Leisure Class*. New York.

Marsh, J.B.T. 2001 Cultural Diversity and the Information Society: Policy Options and Technological Issues, Brussels: European Parliament, DG for Research.

Martin, S. 2003 Is the Digital Divide Really Closing? A Critique of Inequality Measurement in A Nation Online. *IT& Society*, 14, p.1-13.

Mason, S.M. and K.L. Hacker 2003 Applying Communication Theory to Digital Divide Research *IT&Society*, 15, p.40-55.

Merton, R.K., The Matthew Effect in Science. In: R.K. Merton, *The Sociology of Science*: Theoretical and Empirical Investigations, Chicago, 1973.

Miyate, K. 2002 Social Support for Japanese Mothers Online and Offline. In: B. Wellman and C. Haythornthwaite, *The Internet in Everyday Life*. Malden: Blackwell Publishers.

Nie, N.H. and L. Erbring 2002 Internet and Society: A Preliminary Report. *IT&Society, 1* 1, p, 275-283.

Norris, P. 2001 *Digital Divide*: Civic Engagement, Information Poverty, and the Internet Worldwide, Cambridge: Cambridge University Press.

NTIA 1999 US Department of Commerce. *Falling Through the Net: Defining the Digital Divide*, a Report on the Telecommunications and Information Technology Gap in America. http://www.ntia.doc.gov/: US Department of Commerce.

NTIA 2000 US Department of Commerce. *Falling Through the Net: Towards Digital Inclusion*. http://www.ntia.doc.gov/: US Department of Commerce.

NTIA 2002 US Department of Commerce. *A Nation Online*. http://www.ntia.doc.gov/: US Department of Commerce.

OECD 1995. *Literacy, Economy and Society; Results of the First International Adult Literacy Survey*. Paris: Organisation for Economic Co-operation and Development.

OECD 1997. *Literacy Skills for the Knowledge Society; Further Results from the International Adult Literacy Survey*, Paris: Organisation for Economic Co-operation and Development.

OECD 2000 *The Digital Divide: Diffusion and Use of ITs*. Paris: OECD DSTI/ICCP/IE.

OECD 2001 *Understanding the Digital Divide*. Paris: OECD.

Rijken, S. 1999. *Educational Expansion and Status Attainment; a Cross-national and Over-time Comparison*, Amsterdam: Thesis Publishers.

Robinson, J.P. 1968 World Affairs Information and Mass Media Exposure. *Journalism Quarterly 44* Spring: 23-30

Robinson, J.P. 2002 Introduction to Issue 2: IT, Mass Media and Other Daily Activities. *IT&Society, 1*, 2, p. i-viii. http://www.ITandSociety.org .

Robinson, J.P., P. Dimaggio and E. Hargittai 2003 New Social Survey Perspectives on the Digital Divide *IT and Society*, 15, p.1-22

Robinson J. and Godbey, G. *Time for Life,* State College PA: Penn State Press

Robinson J. and Levy, M. *The Main Source*. Beverly Hills CA: Sage

Rogers, E.M. 1995 *Diffusion of Innovations*. Fourth Edition. New York: The Free Press. First Edition 1962.

Rubin, A.M. and Rubin, R.B. 1981. Age, Context and Television Use. *Journal of Broadcasting*, 25, 1-13.

Sachmann, R. en A. Weihmann 1994. *Die Technisierung des Altags, Generationen und Technische Innovationen*. Frankfurt: Campus Verlag.

Steyaert , J. 2002 Inequality and the Digital Divide: Myths and Realities. In: S.F. Hicks and J.G. McNutt, *Advocacy, Activism, and the Internet*; community Organization and Social Policy, Chicago: Lyceum Books.

Steijn, B. 2003 IT en de Organisate van Arbeid [IT and the Organization of Labor]. In: J. de Haan and J. Steyaert, *Jaarboek IT en Samenleving 2003* [Yearbook IT and Society 2003], Amsterdam: Boom, p.153-173.

Tapscott, D. 1998. *Growing up Digital; the Rise of the Net Generation*. New York: McGraw-Hill.

Tichenor, P.J., G.A. Donahue and C.N. Olien 1970 Mass Media Flow and Differential Growth in Knowledge, *Public Opinion Quarterly*, Vol. 34, p.159-170.

Van Dijk, J. 1999 *The Network Society*; Social Aspects of New Media, London: Thousand Oaks / New Delhi: Sage.

Van Dijk, J. and Hacker, K. 2002. The Digital Divide; as a Complex and Dynamic Phenomenon, *The Information Society*, Spring 2002.

Van Dijk, L., J. de Haan and S. Rijken 2000 *Digitalisering van de Leefwereld* [Digitalisation of Daily Life]. Den Haag: SCP.

Van Kesteren, M. and J. de Haan 2000 Digitaal Kapitaal; Verschillen in PC Bezit en -Gebruik door Jongeren en Ouderen [Digital Capital; Differences in the Possession and Use of IT between the Young and the Elderly], *Tijdschrift voor Communicatiewetenschap*, jaargang 28, nr. 3, pp.186-213.

Van Os, R. and N. Jankowski 2004 Digitale Democratie binnen de Gemeente Hoogeveen. [Digital Democracy in the City of Hoogeveen]. In O. Klumper en J. de Haan eds.. *Jaarboek IT en Samenleving 2004* [Yearbook IT and Society 2003], Amsterdam: Boom.

Van Rijsselt, R.T.J.and Weijers, T.C.M. 1997. *Ouderen en de Informatiesamenleving*. [Elderly in the Information Society]. Werkdocument 60. Den Haag. Rathenau Instituut.

Viherä, M.L. 2000 *Communication of Every Digital Life*- Why, How, by What Means, Helsinki: Edita.

Viherä, M.L. 2003 A Mobile Panel to Activate Social Capital – a Case of the Town of Varkaus, unpublished paper.

Wellman, B. et al. 2001. Does the Internet Increase, Decrease or Supplement Social Capital? Social Network, Participation and Community Commitment. *American Behavioral Scientist* 45, p. 437-456.

Zuckerman, H., *Scientific Elite: Nobel Laureates in the United States*, The Free Press, New York, 1977.