Synthesizing Time Geography and Actor-Network Theory

– An ontological discussion combining Time Geography and Actor-Network Theory concepts with regard to telepresence

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Actor-Network Theory treats objects as actors, being controversial in this claim. The reasoning behind this represents their effect on the outcome of the project. In this line of thought I would like to thank an important actor for the writing of this study, my dog Atlas. He along with our daily strolls in the forest represented the *muse* for a great majority of the concepts discussed here.

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Abstract

Geography of the 21th century requires a conceptual understanding of Information and Communication Technologies (ICT) and their impact on society. Some geographers previously treated them as anomalies or succumbing to techno-deterministic predictions and undermining the raison d'être of geography, the importance of distance. The supposedly *death of distance* represents such a techno-deterministic prediction. Nevertheless geographical inquiry retains importance in a modern society dominated by ICT, but the precursors for what distance entails changed. Especially conceptualizing *telepresence* prompts new challenges for geographical understanding; telepresence represents an individual's effect on one or several distant geographical locations with or without time delay. Actor-Network Theory (ANT) conceptualizes the impact of technological systems, claiming this process requires detailed knowledge of technology itself. Several geographic scholars suggested that combing geographical inquiry, Time Geography in particular, with ANT might yield a fruitful approach comprehending modern day ICT implementations and their consequences. Time Geography benefits in this combination among others from ANT's relative concept of space.

This study continuous from the assumption that both frameworks are potentially combinable thereby investigating the possible problems and benefits of such a combination. This investigation examines three empirical cases to extend the theoretical discussion empirically. The three empirical cases represent studies employing Time Geography to explore the impacts of ICT. The investigation departs from the material turn's assumption emphasizing the importance of material presentation.

A content analysis inspired approach analyzes the three studies for their description of *telepresence* involved in ICT utilization, *inspired* because one text yielded two summarizations that represented the basis for the comparison. One Time Geography summarization explicitly used in the text and one ANT summarization interpreted by the author, these two represented the basis for the analysis.

The comparison concluded that a combination of both approaches represents a fruitful enterprise in accordance with the previous literature. The authors of the three texts used several concepts; like social capital or social network analysis, to extend Time Geography and enable comprehension of ICT. These concepts directly related to alliance building and topological networks inside ANT. Thereby a potential combination incorporates useful concepts, expressed in similar ontological fashion. In addition a combination of Time Geography with ANT may represent a quid pro quo for both approaches. One particular example pointed to a possibility of appreciating particular uniqueness of space while retaining relative network topology by applying a dual presentation style. This entails a potential solution for ANT's lack of appreciation of particular space. Departing from knowledge gained during the theoretical discussion and the analysis the study continues building synthesized concepts drawing from both approaches.

The discussion encourages the combination of Time Geography and ANT into a symbiotic new framework utilizing the new synthesized concepts proposed here. Such a unified framework applied to empirical examples of actual ICT implementation and their consequences may yield great insights into the functioning of modern society and ICT.

Key Terms: Time Geography, Actor-Network Theory, ANT, telepresence, Information and Communication Technologies, ICT

Sammanfattning

2000-talets geografi behöver en djupare förståelse för informations- och kommunikationsteknologier (IKT) samt deras påverkan på samhället. Tidigare har dock vissa geografer förklarat geografins död genom att påstå att det fysiska avståndet har tappat sin betydelse. Den så kallade 'death of distance' representerar ett sådant teknologiskt deterministiskt påstående som dödförklarar geografin. Trots dessa domedagsprofetior för geografin som disciplin är dess betydelse och applicerbarhet bekräftad även i en tid av ITK, dock har den exakta innebörden av vad avstånd är förändrats. Därmed kvarstå svårigheter att beskriva den så kallade 'telepresence' där en individ kan ha påverkan på flera platser samtidigt utan fysiskt närvaro, med eller utan tidsfördröjning. Actor-Network Theory (ANT) beskriver denna process genom att tillskriva aktörskap till själva objekten och hävda att bara genom djup förståelse av teknologins funktion kan man förstå teknologins påverkan på samhället. Flera geografer förespråkar därför en syntes mellan ANT och geografi, särskilt tidsgeografi, för att få bättre förståelse för konsekvenserna av IKT.

Denna studie utgår ifrån att ANT och tidsgeografi är förenliga; härmed undersöks vilka för- och nackdelar en sådan syntes kan innebära. Undersökningen fokuserar på tre empiriska fallstudier i vilka tidsgeografin används för att förklara konsekvenserna av IKT. Undersökningen håller sig till det så kallade 'material turn', vars etos eftersträvar enbart materialistiska förklarningar.

Två interpretationer kunde extraheras, en explicit beskrivning av tidsgeografin och en beskrivning av ANT tolkad av forskaren. Dessa extraherades enligt principer för innehållsanalys så långt det var möjligt. De två interpretationer användes för att sedan jämföra de båda ansatserna och identifiera de områden där de överlappar respektive skiljer sig åt.

Jämförelsen visar att en kombination av båda teorier är möjlig och överensstämmer med tidigare forskning. Alla tre studier använde sig av diverse koncept såsom 'social capital' och 'social network analysis' för att utöka tidsgeografin i hopp om förståelse för IKT och dess konsekvenser. Alla dessa koncept har raka motstycken inom ANT, såsom alliansbyggande och topologiska nivåer inom nätverk. Därmed skulle en möjlig syntes kunna inkorporera dessa koncept och utrycka dem i ett enhetlig ontologiskt synsätt. Dessutom skulle en sådan syntes också vara fördelaktig för ANT. Bland annat skulle det tidsgeografiska angreppssättet bli fördelaktigt för ANT som för närvarande har svårigheter att beskriva unika platsers påverkan på nätverket. Studien avslutas med att introducera ett antal koncept, skapade av syntesen mellan de båda teorierna med syftet att tjäna som en språngbräda till en potentiell, helt ny teori.

Uppsatsen uppmuntrar till en kombination av tidsgeografi och ANT i en symbiotiskt ny teori. En sådan skulle kunna bidra till nya insikter och förståelse för IKT samt dess betydelse för samhället.

Nyckelbegrepp: tidsgeografi, Actor-Network Theory, ANT, telepresence, informations- och kommunikationsteknologier, IKT

Zusammenfassung

Geographie im 21. Jahrhundert braucht ein tiefes verstehen der Konsequenzen von Information und Kommunikation Technologien (IKT) auf unsere moderne Gesellschaft. In der Vergangenheit haben einige Geographen fast ihre eigene Disziplin für tot erklärt, indem sie geleitet von Techno-Determinismus, den sogenannten „Death of Distance“ ausgerufen haben. Die Geographie behält aber trotzt diesen neuen Verhältnissen ihre Bedeutung auch in einer Zeit mit ITK, jedoch änderte sich die Voraussetzung für die Bedeutung von was das Konzept *Abstand* beinhaltet. Zum Beispiel das Konzept der telepräsenz ist problematisch geographisch zu beschreiben; wo eine Person Einfluss auf mehre Orte gleichzeitig hat, mit oder ohne Zeitverzögerung. Die Actor-Network Theory (ANT) beschreibt dieses Konzept indem sie Objekten handlungsvermögen zuschreibt und behauptet das nur ein solch komplettes Verstehen von der Funktion von Technologie ermöglicht ein Verständnis ihrer Konsequenzen. Mehrere Geographen favorisieren eine Synthese von ANT och Geographie, Zeitgeographie um genau zu sein, um diese Probleme besser zu hantieren.

Diese Studie geht davon aus das ANT und die Zeitgeographie vereinbar sind, damit soll untersucht werden welche Vor- und Nachteile eine solche mögliche Synthese beinhaltet. Dies wird untersucht mit dem Ausgangspunkt in drei empirischen Fällen die sich der Zeitgeographie bedienen um die Konsequenzen von IKT zu beschreiben. Die Beschreibung begrenzt sich zu dem so genannten „material turn”, dessen Ethos ausschließlich materielle Erklärungsmodelle nachstrebt.

Zwei Interpretationen der empirischen Fälle wurden extrahiert, eine explicit genannte Beschreibung der Zeitgeographie und eine Beschreibung von ANT interpretiert vom Autor. Diese wurden kreiert so weit es möglich war nach Prinzipien der Inhaltsanalyse. Die zwei Interpretationen stellten die Grundlage für den Vergleich der Theorien und ihrer Beschreibung von IKT, dadurch wurde identifiziert welche Gebiete gleich sind und wo sich die Ansätze unterschieden.

Der Vergleich der Theorien zeigte dass eine mögliche Kombination beider durchaus möglich ist, dies stimmt überein mit den anderen Forschungsresultaten. Alle drei empirsichen fälle benutzten Konzepte wie „social capital“ oder „social network analysis“ um die Zeitgeographie zu erweitern um die Konsequenzen von IKT besser zu verstehen. All diese Konzepte haben direkte Gegenstücke in der ANT, wie das knüpfen von Allianzen und topologische Niveaus von Netzwerken. Daher kann eine mögliche Synthese beider Theorien diese nutzvollen Konzepte inkorporieren und in einer ontologischen einheitlichen Weise beschreiben. Außerdem kann eine solche Kombination mit der Zeitgeographie auch vorteilhaft sein für die ANT, weil diese Probleme hat den spezifischen Effekt von einer geographischen Lokalisation auf das Netzwerk zu beschreiben. Der Klimax dieser Studie repräsentiert die Introduktion von einer Anzahl Konzepten die sich auf beide Theorien beziehen.

Diese Arbeit mahnt zu einer Kombination beider Theorien in eine symbiotische neue Theorie. Diese neue Theorie kann hoffentlich dazu beitragen neue Verständnisse und Einsichten zu schaffen über IKT und dessen Bedeutung für eine moderne Gesellschaft.

Wichtige Begriffe: Zeitgeographie, Actor-Network Theory, ANT, telepräsenz, Information und Kommunikation Technologien, IKT

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Abbreviations

Time Geography:

NTP	network time prisms
TSP	time space prism
TSS	time space station

Actor-Network Theory:

ANT	Actor-Network Theory
post-ANT	Actor-Network Theory after the adoption and extension as an answer to the criticism and problems faced by ANT. For sake of simplicity the concept is treated synonymous with the term ANT, if not explicitly mentioned.
OPP	obligatory point of passage

Other:

CS	CouchSurfing or couchsurfing.org
ETH Zürich	Eidgenössische Technische Hochschule Zürich
F2F	face-to-face communication
GIS	Geographical Information System
ICT	Information and Communication Technologies
LSBN	location based social network
RASTT	retail aggregate space-time trip model
SNS	social network system space

1. Introduction

Information and Communication Technologies (ICT) represent an integral part of today's modern societies. An estimated 80 percent of the Swedish population accessed the internet regularly as of 2008 (Thulin and Vilhelmson 2010: 3). Consequently ICT profoundly affects people's everyday lives in Sweden and beyond. I myself represent no exception to ICT usage; it represents a major part of my daily routine. The following timetable constitutes my activities on the 2nd of April 2012:

07:30 waking up in the morning and conducting my morning hygiene
followed by checking my email and facebook, engaging in facebook chat, liking facebook statuses, commenting facebook statuses
conducting bank errands through the online portal of handelsbanken.se

08:00 eating breakfast and reading the newspaper

08:30 leaving home for the morning exercise, a 2.5 km run in the forest with my dog

09:10 returning from the run
preparing the dog food and feeding the dog

09:15 having a quick shower to fresh up from the run.

09:20 spending a few minutes playing online role playing game of SilkroadOnline

10:00 starting to write

These represent the majority of my activities conducted on the morning of writing the first draft for this introductory chapter. My physical location corresponded to the north eastern outskirt of the city of Gothenburg, Sweden. During the whole morning I never moved further than 5 km away from my place of residence. Nevertheless aided by ICT I extended my reach far beyond this localized pocket of physical space. Thanks to the aid of the internet I conducted banking errands, engaged in social-networking with friends in Sweden, Canada and Jamaica and leisure activities with peoples of unknown origin and identity. The geographers Raubal et al. (2004) describe this phenomenon as *telepresence,* the ability to interact with a physical distant location without being materially present thanks to the aid of technology (Raubal et al. 2004: 245-265). Constituting a sphere of influence far greater than my physical reach, the actual size corresponds to the ICT's involved. Theoretically I can access any kind of information and engage in any kind of activity as long as it is permitted by technology, regardless of geographical location. Introducing these types of space transcending technologies into our homes transformed the meaning of *home* (Oudshoorn 2012: 127). For my personal case home still represents a personal retreat, however new properties are added due to ICT. These new properties represent writing this master thesis (educational), conducting bank errands (economical), working (professional) and lots more, creating a multipurpose location enabled by ICT.

Thereby ICT implementation fundamentally changes people's activity patterns. The geographer Couclelis (2009) recognizes that traditional assumption of confinement of place and activity in today's "*theoretical geography, regional science and urban and regional planning become questionable*" due to these technological advances (Couclelis 2004: 52). Geography faces entirely new modes of spatial organization and how people relate to space.

Shifting from personal focus to large scale, these changes create drastic effects. The Arab Spring of 2011 is a vivid example of the power of new social media in an Internet Age. With the help of social medias like facebook and Twitter decade long dictatorships of the Middle East crumbled in the matter of weeks, while the world watched on 140 characters live feeds (the character limit of twitter messages).

"Nearly 9 in 10 Egyptians and Tunisians surveyed in March [2011] said they were using Facebook to organise protests or spread awareness about them" (The National 2011)

The implications of these technologies are enormous for geography. Ever since the proclamation of the *death of distance* (Mitchell 1995) geography struggled with comprehending the geographical complex implications of ICT (Urry 2003). Fortunately Geography is not alone in facing this complexity. The so called *material turn* represents a trend in recent social sciences acknowledging the importance of understanding material systems and their implications on society (Bennett and Joyce 2010). The material turn advocates a larger material focus of the social sciences including human geography, hence the name. A great proponent of material explanations is Actor-Network Theory (ANT). ANT claims understanding the implications and effects of technological systems, necessitates understanding how technological systems function and operate (Latour 1996). The geographers Couclelis (2009) and Schwanen (2007) point to ANT as a possible source of inspiration. To understand technological systems and their spatial consequences Geography, and Time Geography in particular, needs openness to new ideas according to them.

1.1 Problem Definition

One of the problems ICT creates for geographical understanding constitutes explaining and conceptualizing simultaneous action on geographical distant location, i.e. *telepresence*. Distance still retains importance in a world dominated by ICT (Urry 2003, Couclelis 2009) however the implication of distance for particular human action changed. Answering what these changes entail necessitates a geographical framework capable of incorporating ICT and not treating it as anomalies (for an example look Pred 1981). Schwanen (2007) points to ANT as a possible source of inspiration for such an encompassing framework. Geographically he departs from the concept of Time Geography discussing how it ontologically relates to ANT, concluding that both concepts are more or less compatible. This studies intention is continuing Schwanen's ontological discussion by focusing on particular empirical cases and how these relate to the possible synthesis of concepts drawing from both approaches.

1.2 Aim

The study aims at comparing Time Geography's description of *telepresence* to an ANT's description of *telepresence* to generate synthesized concepts drawing from both approaches. The descriptions results from three empirical studies, all three attempt building a Time Geographic methodology explaining ICT and the corresponding *telepresence*. The research questions addressed to the particular studies are:

- *How does Time Geography describe telepresence?*
- *How would ANT describe telepresence?*
- *How do these two concepts compare?*

To answer the overarching research question of:

- *What concepts does a synthesis of Time Geography and ANT create?*

The discussion of the concepts restricts itself to the material perspective common in ANT and Time Geography (Schwanen 2007). The comparison constitutes a theoretical discussion based on these three empirical studies. The concepts of; time, space, actor, network and change are central to the discussion and discussed from a theoretical and empirical vantage point for Time Geography and ANT respectively.

The intention of this particular study represents furthering the creations of a geographical framework capable to understand and comprehend the implications of ICT for society. Such a framework may result from a combination of ANT with Time Geography. This particular study aims at outlining and discussing the ontological possibilities and challenges of the combination of two theoretical approaches creating synthesized concepts as point of departure for a future combination. Materiality and spatial impact of ICT represent the focal point of this discussion. The main contribution of this particular study represents broadening the academic debate about understanding the implications of ICT. This understanding in term hopefully creates a rich compilation of knowledge benefiting society in general.

1.3 Delimitations

The research topic represents an enormous area of inquiry; therefore delimitations are integral to the realization of this study. The high amount of complexity involved creates the impossibility addressing every possible aspect inside the scope of a master thesis. The first delimitation represented confinement to discussing how the two approaches are applied and what problems and benefits arise, instead of validating the approaches in general. Thereby this discussion represents a second level abstraction, second level in the sense that empirical data represents the foundation, first level abstractions are represented by theories and second levels abstraction are the comparison of different theories and approaches. With this high level of abstraction it's impossible to simultaneously defend the justifications for these particular abstractions and discus how they relate to one another inside the scope of a master thesis. Therefore this study focuses on the relation of the concepts, not their justifications for the particular choice of abstraction.

Practical delimitations for the study represent only focusing on Time Geography and ANT. In particular classical Time Geography and modification based upon this framework, because this interpretation represented the main datum of the analyzed studies and literature. The empirical discussion departs from three empirical studies using Time Geography as an analytical framework for ICT implementation. The same studies represent the source of the ANT interpretation for the comparison. The choice for this dual purpose of these studies reflects the difficulty of finding three pairs of studies analyzing the same or similar aspects of ICT implementation with focus on telepresence using Time geography and ANT respectively. The choice of study type faced delimitations imposed by ANT's requirement of detail. This restricted the choice to dissertations or research reports with voluminous elucidation of their methodology and result. Further practical delimitations are described in the methodological chapter.

The intention of this discussion represented covering a considerable part of all ICT implementation despite the practical delimitations imposed. This intention resonates in relying only on the phrase "time geography" for all database searches for the studies.

1.4 Disposition

The next chapter represents an introduction to the extend ICT implementation permeates modern society. Alongside a presentation which particular challenges this poses for understanding, for geography in general and Time Geography in particular. The chapter concludes with different solutions proposed solving these difficulties, among other the solution discussed here by Schwanen (2007) representing in a sense previous research in the area. The theory chapter represents a presentation of the both approach alongside a discussion how the main tenants of both Time Geography and ANT relate to each other. Chapter 4 represents the methodology for the reading of the empirical studies, explaining the search criteria for the three case studies and the content analysis inspired review of the three selected studies. Chapter 5 and 6 represent the presentation of the case studies and the analysis of the approaches respectively. Both chapters serve to elaborate and investigate the differences, similarities and possibilities of combining the two possible approaches to finally synthesize concepts drawing from both approaches. The study concludes with the discussion of the results, methodology, possibilities for a combined framework and general reflections of the author about the research topic.

2. Background

This chapter elaborates the concept of telepresence and outlines Information and Communication Technologies (ICT) usage and their impact on society. In addition the chapter discusses the difficulties encountered by Geography, Time Geography in particular, when conceptualizing telepresence and ICT. The chapter begins with elaborating telepresence.

2.1 Telepresence in Information and Communication Technology

ICT represents "*electronic information technologies that are used to bridge geographical distances, allowing people to interact with other people, organizations, and devices that are not physically present*" (Thulin and Vilhelmson 2010: 4). Decisions to use ICT instead of other forms of communication have spatial implications. A single person's choice to stay at home download and watch a movie instead of going to the cinema is negligible. However if this practice becomes widespread, initial conditions also change for other participants beyond the individual users. In this hypothetical scenario cinemas, movie retailers and similar lose their customer base and in extreme cases declare bankruptcy. These changing practices change economic conditions for companies involved in the movie and movie retail industry. This in term has spatial consequences for society, by changing how movies are accessed and distributed (Thulin and Vilhelmson 2010: 1). This represents one example how telepresence effects society.

Telepresence occurs when one is able with the help of technology to project oneself beyond ones physical boundaries (Raubal et. al. 2004). Telepresence is one kind of presence, usually being denoted to forms of contacts that do not occupy the same physical space. Letters and books represent physical analogues to telepresence; these constitute well understood phenomena since they act with temporal delay. One major difference in today's form of telepresence is the synchronicity. Instantaneous action on two or several geographical location simultaneously, creates great difficulties for analytical description with classical geographical models (Couclelis 2009; Urry 2003; Raubal et. al. 2004).

People in addition to Face-to-Face interaction (F2F) always communicated with geographical distant people using different technologies other than personal travel (Urry 2003: 158). Traditionally these took the shape of letters, carrier-pigeon, and messengers as forms of information transfer from one location to another. Other forms of information transfer that do not involve F2F interaction, constitutes leaving notes or messages at a specified physical location. Thereby information transfer occurs at different points in time confined to same location. The qualitative and quantitative difference in today's forms of telepresence by contemporary digital ICT are the instant information transfer and their large scale implementation into the fabric of modern society.

The group of geographers Raubal et al. (2004) composed a list of all different types of presences. They distinguished these by their temporal aspect, emphasizing common occupation of a particular space. Splitting into two different types of presence:

Synchronous Presence: requiring convergence in time and space for at least two individuals. This is typically referred to as F2F interaction. This type of communication is the most basic form of human interaction.

Asynchronous Presence: requires convergence in space but not time, this type of presence referrers to the writing of notes or messages either for oneself or for others. Examples of this type of presence are Post-It notes, hospital charts or similar.

In telepresence the space requirement is missing. Raubal et al. distinguishes into two different types of telepresences:

Asynchronous Telepresence: requires neither convergence in time or place. Information exchange is neither specified to location or time. Examples of this kind of telepresence are emails, web pages.

Synchronous Telepresence: necessitates temporal convergence. The space requirement is absent because of the telepresence, but temporal convergence is necessary for information transfer. Examples are radios, television, telephone or live chats etc.

According to this interpretation telepresence is a mean of information transfer between entities. The major difference, opposed to normal presence, is the removal of the spatial requirement. This allows for information transfer regardless of geographical location. Like mentioned above today's forms of telepresence differ from traditional forms of telepresence. Communication by ICT, telepresence, may soon represent the major form of communication between individuals in modern societies (Urry 2003). F2F interaction is not disappearing anytime soon, but remote forms of communications are drastically increasing. This represented the quantitative difference to older forms of telepresences. Together the quantitative and qualitative differences in modern telepresences entail profound consequences for society. This study contributes to the better understanding of these consequences.

This understanding necessitates the recognition of the materiality of society (Urry 2003). Without the use of any sort of technology only synchronous presence is possible. The modern ICT implementations created *"a world in which transcontinental communications have become both inexpensive and common"* (Greig 2002: 229). This recognition of the materiality is in accordance with the so called *material turn* in the human sciences. Bennett and Joyce (2010) claim it's imperative to understand recent development in ICT to create a comprehensive picture, as a picture without emphasizing the material aspect misses the essence of what it wants to describe. Next follows a statistical walkthrough of ICT implementation, to show how vast the utilization of ICT is in today's modern society.

2.2 Impact on Society

ICT utilization represents an integral part of modern day society. This is exemplified by the billionth internet user registered in 2005 (Urry 2003: 158). Figure 1 shows ICT utilization in Sweden as of 2008.

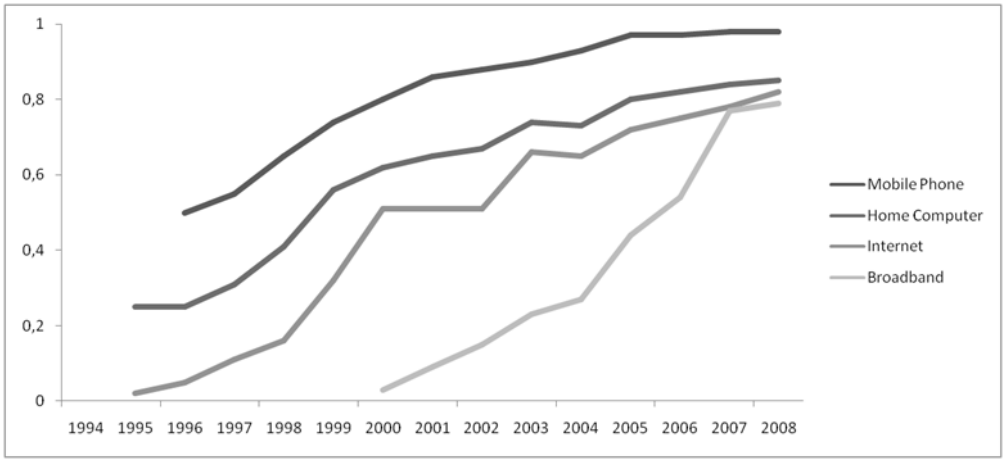

Figure 1: access to ICT technologies in Sweden 1995 – 2008, represented as percentage of the population, the graph is a composite from different sources, source: Thulin and Vilhelmson 2010: 3

In Sweden over 80% of the population accessed the Internet regularly and owned a personal computer. More than 65% had a personal email address and 75% access to high speed broadband connections in their homes. Mobile phone coverage reached almost saturation level, corresponding to 95% of the population owning a mobile phone (Thulin and Vilhelmson 2010: 2). These figures validate the assumption of extensive implementation of ICT into modern societies (Urry 2003).

ICT companies today represent a major pillar of the economy using technologies nonexistent just 5, 10 or 20 years ago, depending on which technology one is referring. ICT created a whole new sector of e-commerce and ICT related businesses. No uniform definition of e-commerce is available; however the phenomenon is ever-growing. According to the US Bureau of Census's earliest data on e-commerce in the USA as of late 1999 indicated a volume of sales constituting $5.3 billion, growing to $7.0 billion dollar in the first quarter of 2001. This represented only 0.91 % of retail sales in 2001 in the USA (Couclelis 2004: 44), however nothing stopped this exponential growth trend during the last decay. Forbes magazine listed Apple and facebook as being one of the most successful companies, admiring their business models exploiting the possibilities created by ICT implementation (Forbes 2011). In May 2012 when facebook made its shares public and registered at the stock market its stock value reached an estimated $16 billion. Representing the third highest initial public offer ever, placing them third behind Visa at $19.7 billion and then General Motors at $18.1 billion (MoneyMorning 2012). ICT networks are similar to railroad, street and airport networks, increasing in value the more nodes are connected. One email address is useless, but if every 100th person on the planet has an email address the network value is increased. Again it gains worth when every 50th, every 10th gets an email address, constantly increasing in value all the way (Urry 2003: 162).

Another fast growing ICT economic sector represents smartphones. The Financial Times reported that sales figures for so called smartphones expected to increase from $459 million in 2011 to $657 million in 2012 (Financial Times 2011). This constitutes an increase in worldwide sales of over 40 % in just one year, representing a staggering growth rate compared with other economic sectors. The smartphone combines internet accessibility and other functions within the mobile phone, serving as a testimony of ICT's constant renewed innovation and implementation.

These are just a few examples on how widespread ICT usage and the connected telepresence have developed in recent years. Constant expansion and innovation is an inherent feature of modern ICT usage. Still widespread ICT implementation is a fairly recent phenomenon. Therefore the predictions for the outcome of this implementation assumed a very speculative character in the past. Next follows a walkthrough of some of these speculations before continuing to the outcome that ICT implementation actually had.

2.3 Predicted Development

The initial predictions of widespread ICT implementation ranged from fantastic possible scenarios to Orwellian adaptations. The proclamation that *distance is dead* represented one such fantastic prediction. At the end of the 20th century distance supposedly lost its importance and no longer represented an inhibiting factor for economical or social interactions. (Couclelis 2004: 42-43) The majority of the research championing this claim focused exclusively on governmental, business, work or the educational sector omitting largely implications on people's everyday lives. This technologically focused research advocated the benefits of digital technological solutions over traditional techniques. This created such a techno-deterministic belief that physical space lost its relevance (Thulin and Vilhelmson 2010: 5). Despite these claims space still retained the importance allocated by geography, every process giving credence to the hypothesis distance is dead needed substitution by a real life mechanism to ensure function. On the contrary the *tyranny of distance* stood corroborated today's material systems are subject to the same rules as social systems before them (Couclelis 2004: 41). In retrospect the literature reached a consensus that the techno-deterministic claim of the death of distance was not corroborated by empirical data (Couclelis 2004: 41 & Thulin and Vilhelmson 2010: 5 & Urry 2003: 156).

Huntington (1996) expressed a more dystopian version of the future with his "*Clash of Civilization*" thesis. He predicted that cultural conglomerates fuelled by the spread of western culture, ICT and rapid globalization would antagonize each other in an Orwellian fashion after the end of the cold war. This spread of western ideals supposedly created a volatile situation of cultural conflict. This line of argumentation simplifies cultural adaptation into a binary relation, either acceptance or resistance. Despite the increased contact between cultures this eat-or-be-eaten scenario never materialized. Rather cultural adaptation took the form of hybridization or creolization, where increased ICT access and resulting cultural exposure produced more cultural diversity (Greig 2002: 225-241). In cases leading to cultural heterogenization, especially immigrants maintained a sense of cultural identity despite large distance between their place of residence and their place of origin. Highlighting multiplicity in identities of people, being at the same time central to the community they work in, but also marginal in the cultural setting they are placed in (Adamas and Ghose 2003: 417). All these different scenarios of cultural adaptation created more open-mindedness about other cultures but also exposed tensions inside older cultures, creating a mixed blessing for cultural development (Greig 2002: 242–243).

Despite these techno-deterministic and dystopian predictions it is true that technology changed human interaction at a distance. ICT greatly facilities human interaction at a distance and reduces the friction of distance, as well as creating new ways of connecting rather than replacing older means of communication (Thulin and Vilhelmson 2010: 8-10). The relationship between e-commerce and regular commerce assumed a complimentary relation, rather than being binary exclusive (Couclelis 2004: 46). Creating the realization that widespread ICT usage indeed profoundly changed modern society, but in discrete ways instead of an abrupt change (Urry 2003: 159). Next follows a short introduction into some of these changes.

2.4 Changes to Society

The ease of communication at a distance facilitated by ICT changed how people interact socially. The usage of the internet, thought to replace physical travel. However the mobility of modern of populations is breaking recorded levels, both domestic and international. In addition internet usage is more widespread than ever before (Urry 2003). Internet usage, mobile phones and computers became such an integral part of everyday life that the younger generations take them for granted. Internet usage among young people serves multiple functions: communication, entertainment and educational to just name a few. The space transcending virtual mobility enabled by ICT represents an ever-growing part of everyday life (Thulin and Vilhelmson 2010).

Urry (2003) observed that people working with this new form of media shared five major characteristics. First they were all highly individualized, valuing own initiative and responsibility, secondly having ephemeral but intense social relations with other individuals. Thirdly they treated unknown people as potential-people-not-yet-met instead as strangers. Fourthly work and play assimilated. Lastly he recognized that their social relations were deeply embedded within the new social networks; mobile phones, emails, facebook and such. Therefore he draws the conclusion that that social life, at least in the developed nations is becoming increasingly networked (Urry 2003: 168-170).

Business models, economic structures and laws adapted to the new conditions created by ICT implementation. The e-commerce sector affected certain retail goods more than others. Everything depending on chains of refrigeration, mainly speaking groceries that are distributed to local stores, experienced only marginal effects. On the other hand business model of retailers distributing highly priced electronic goods shifted to more online sales, because these goods are shippable over long distances without losing value. The same applied to the distribution model of music, movies, video games and software, because they easily dematerialize and their virtual transfer demands only internet access (Couclelis 2004: 44). The easy distributions of virtual data on the internet lead to elaborate formulations of copyright infringement laws to prevent piracy (USA Law Code). The difficulties involved in differentiating between copyright infringements and denial of free speech surfaced during the lawsuit against thepiratebay.org (DN 2012). This represents a testimony to the complexities involved in ICT adaptation of broader society.

Local business fared significantly better retaining their competitive advantage in offering consumer service and establishing a trust relation to the customers, being rather difficult to remodel online. These changes created a world were costumers' use both means of acquiring goods, depending on which is more convenient for the particular situation. The implementation of these new opportunities that ICT offered combined with already existing strategies led to no drastic, abrupt

change in people's behavior (Couclelis 2004: 44-46 & Thulin and Vilhelmson 2010: 15). Rather than replacing older forms of interaction, telepresence assimilated with traditional strategies. Corroborating the assumption that wide spread ICT implementation has structurally and spatially changed society, as people find new ways in adopting its uses (Thulin and Vilhelmson 2010: 2 & Urry 2003: 167). The next part represents the basis for the assumptions made in this study, outlining the challenges that these implementations take to understanding and their possible solutions.

2.5 Challenges to Understanding

These different transformations to people's everyday life pose a number of challenges, both for the individuals themselves and analytically for geographers. Vilhelmson and Thulin (2010) conclude that no straight forward relationship exists between ICT usage and everyday activities. ICT usage corresponded more with the advance and increases of other types of activities rather than being a goal in them self, exemplified in the increase of F2F meeting opportunities by moderate ICT usage. Moderate ICT usage enabled people to network with friends facilitating more F2F meeting between friends, while heavy usage corresponded to less physical meeting as these shifted to virtual communication instead. Further complexities like gender differences in ICT usage also emerged from empirical studies. Young females tended to prefer usage of mobile phone as means of communications, while young males preferred the internet and other text based forms of communication. The same study also showed that teenagers expressed anxiety, leading to feelings of exposure and uneasiness as a result of perceived lack of privacy because of continuous ICT access (Thulin and Vilhelmson 2010). These represent just a short selection of complexities that emerged from one particular study examining ICT habits of young people.

New social networks created with the aid of ICT, are less coherent and have fewer overlapping spheres of affiliation if compared to older social networks. This makes them more fluent and dynamic. Urry (2003) claims that the social sciences usually treat virtual social networks as person-to-person interactions. According to him this ignores the material aspect of these emerging ICT aided social networks. Which includes: technical infrastructure, transportation of people and information, standardized procedures etc. that are all necessary to maintain the function of these networks. This insight enables him to claim that technology and society are intrinsically intertwined, without technology no society and vice versa (Urry 2003: 159-161).

This complexity creates great difficulties in predicting the future of ICT and the correlated new forms of telepresence it creates. Lessons learned from older space-transcended technologies, like the car, suggest that defiance to expert opinion is the norm rather than the exception. New innovations in ICT already adopt this pattern. The Short Message Service (i.e. sms) initially thought for primary usage among stock brokers and business people to convey business details, radically changed its purpose and function when adopted by the younger generation. It became a cheap form of communication between young people, when calling was not an option or desirable (Thulin and Vilhelmson 2010: 5-11).

Old tenants of geography are being undermined by the advent of ICT, even though the *tyranny of distance* stands corroborated. Couclelis (2009) and Raubal et al. (2004) claim that geography as whole needs adaptation to fully explain and appreciate the far reaching changes ICT brought to society. Vilhelmson and Thulin (2010) apply Time Geography to explain teenagers' virtual and physical interaction. They deem it necessary to extend Time Geography to retain its analytical vigor.

Urry (2003) recognizes that no reductionist science adequately deals with these complex emerging networks, leading Couclelis (2009) to find inspiration in Structuration and Actor-Network Theory for accommodation of these effects of ICT within geography. She claims these particular bodies of work advocate a relative concept of space useful for understanding the interaction of different spheres common in ICT utilization. Before discussing possible solution let's focus on the challenges this creates for Time Geography in particular.

According to several geographers Time Geography faces difficulties explaining ICT implementation (Thulin and Vilhelmson 2010; Raubal et. al. 2004; Couclelis 2009; Schwanen 2007; Pultar 2011 & Yin 2011). One difficulty represents that traditionally people occupied fairly localized pockets of space therefore spatial movement posed a good indicator for activity. Today activities are much more dispersed trough both time and space as enabled by the use of technology (Couclelis 2004: 47). This recognition let Couclelis (2004) among others; to develop the *fragmentation of activity hypothesis*. She claims, due to the fluidity of activity the place focus of classical Time Geography becomes difficult to maintain. Only a Time Geography incorporating an individual activity focus is capable of handling the fragmented activity patterns of modern day ICT usage (Couclelis 2009: 1559-1560). Pred (1981) in the early 1980s acknowledged that *"exceptional circumstances arise when a telephone call is part of the project"* (Pred 1981: 253). In today's society treating a phone call as an *exceptional circumstance* is questionable. In terms of times of occurrences or importance to everyday life a phone call is everything but exceptional. Therefore treating it as a negligible anomaly to the geographic framework is no longer a viable option (Couclelis 2009: 1560). Schwanen (2007) claims that Time Geography faces difficulties interpreting particular outcome of life paths inside time-space prisms (TSP) when ICT or objects fulfill certain functions. Next follows a review of a selection of attempts addressing these issues and proposing possible solutions.

2.5.1 Possible Solutions

Thulin and Vilhelmson (2010) claim the complex interaction of virtual and physical sphere represent a challenging analytical environment. Different solutions are proposed to handle this analytical difficulty created by modern telepresence within Time Geography.

Couclelis (2009) proposes a solution that involves the use of Foucault's notion of discourse. She suggests that virtual commodities represent *"objects of discourse"* (Couclelis 2009: 1564). These objects do not necessary correlate to the material world but rather they are constructed and imbedded within the discourse and through this they imbue immaterial connections with a conceptual framework and a place to occupy, meaning the discourse itself. This allows for visualization of the discourse, in the same sense that a map is a representation of the physical world. This notion expands the three-dimensional space-time model of Time Geography into a multidimensional structure representing purposeful activity. Circumventing the problem of depicturing purposeful human activity in the virtual sphere that she claims Time Geography suffers. The idea of human activity as objects of discourse presents a novel idea proposed by her treating human action as indivisible whole, involving cognitive aspects and artifact-using humans.

The presentation of the discourse in coordinate system and using GIS analysis is another novel concept by her opening of for methodological possibilities. The restriction generated by ethical difficulties inherent to the collection of data creates problems for her proposed analysis. For example asking for the reasons why people do certain things represents possible source of conflicts, because of peoples need for privacy. Her confidence in anonymizing and randomizing individual responses to circumnavigate this ethical problem is high. Solving the ethical issues opens for the understanding of second order effect, she exemplifies:

today's bosses and CEOs move into the globalizing ICT world, the more the low-ICT nannies, cafeteria workers, and janitors will likely need to readjust their own daily movements and schedules. The causes of that kind of leader-follower effect would not be directly detectable using conventional time-geographic approaches, but should be plainly visible in a framework which permits the simultaneous representation (Couclelis 2009: 1573).

A further possible solution introduces Raubal et al. (2004). They draw upon Gibson's concept of *affordance.* Affordance is a physical property that is inherent to an object. Affordances are utilized by a user or not, depending on the capabilities of the user. The concept when extended to Time Geography transforms the shape of the TSP by extending it according to the different affordances realized by the user. He introduces a *cognitive constraint* accounting for the possibility of realization. This represents an additional separate constraint to Time Geography's three classical constraints. The cognitive constraint takes its point of departure from the user. The cognitive capabilities of a user in this sense become a separate constraint, defining the possibility to utilize affordability or not. Practical implementations of cognitive constraints into the TSP are similar to authority constraints in that they create negative space inaccessible by the user.

The integration of affordance allows a space-time mechanism and human interaction as individual-specific-action-possibilities. However they acknowledge that such a framework requires collection of high amount of details not possibly obtainable with today's collection methods. Therefore current concrete implementations need to adapt to this equivocal situation for real time calculation. They acknowledge that contemporary technical or analytical methods failed in practical applications. Therefore they conclude further work is required to create a viable framework alongside practical guidelines for implementation into technical devices utilizing this model for behavior prediction (Raubal et. al. 2004).

The last solution I would like to discuss is the one given by Schwanen (2007). The solution he discusses represents the primary foundation of this study. He points to the ontological similarities between Time Geography and Actor-Network Theory (ANT), highlighting that both approaches emphasize the importance of physical reality to human interaction. Thereby according to him the two approaches are compatible and a combination potentially addresses issues within both approaches. ANT has a radical definition of the concept of actor in that everything that alters a physical state is an actor, human or not. Although classical Time Geography advocates a less bold version, Time Geography's notations are nevertheless regarded as a democratizing move between objects and humans, allowing for neutral representation of both. The solution ANT offers is that it allows for the agency of objects. This new definition of actor enables technological material descriptions of the particular outcomes of life paths. Schwanen claims that even without the complexities introduced by ICT Time Geography faced difficulties in this regard.

He exemplifies this difficulty of interpretation with a mother being late for work while she is still on her way to bringing her child to the nursery. Despite her being late she returns home to fetch he child's favorite toy, a teddy bear. The reason behind this represents her intention of being a good mother, because she knows her child cannot have his midday sleep without the toy. Therefore she chooses to risk delaying her workday even further instead of jeopardizing the child's sleep. He claims this type of life path is difficult to interpret without acknowledging the agency of objects, in this case allowing the child to sleep.

With this in mind he explains action at a distance as the agency of objects. He continues with the nursery example, wherein the staff receives written notes by the parents explaining the child's condition and their desires for the child's treatment and activities. The interpretation of these notes involves a degree of uncertainty, for example that the writing is illegible or the note is simply lost. In this case the primary at a distance action represented by the note is supplemented with a phone call to the parent representing another at a distance action. Schwanen claims both case represent agency of objects enabling action at a distance (Schwanen 2007: 16-19). Thereby ANT represents a possibility for him conceptualizing action at a distance within Time Geography.

2.5.2 Hypothetical Example

In addition to creating a possibility to handle the complexities created by the fragmentation of activity. ANT represents a field of inquiry that prides itself on incorporating the material dimension of society. Furthermore ANT not only incorporates relativism it's embracing it (Latour 2007). ANT being an integral part of the material turn it represents a good candidate for fulfilling Urry's (2003) requirements of embracing materiality and relativity in order to understand ICT.

How can this material focus handle the complexities and difficulties involved in understanding ICT implementation? Schwanen touched the at a distance properties of objects. But how does this correspond to a concrete empirical case involving ICT? To exemplify this analytical difficulty imagine the following hypothetical example:

Assume that person A engages in a viedo chat with an acquaintance, person B. Both talk about the events of the day and at the end of the conversation they decide to meet at a local bar and take a few drinks.

The physical location of A and B and the bar they meet later on, represent the physical sphere in this example. The chat medium they used may correspond to Skype or similar, represents the virtual sphere that both are interacting with. How do these spheres interact? This analytical question might be asked by a hypothetical researcher investigating the interaction between physical and virtual spheres. This question presumes a causal relation between the two spheres. Answering in which sphere the decision occurred represents a possible way addressing this issue. Two possible alternatives arise:

Alternative 1: the physical sphere, because both individuals occupy a physical location, therefore the decision belongs into the physical sphere.

Alternative 2: the virtual sphere, because both individuals need to interact virtually to make the decision, therefore the decision belongs to the virtual sphere.

Both arguments neglect and emphasize different aspects of the situation. Departing from materiality outlined above creates a new type of interpretation. Both individuals need material connection for information transfer. Both people are materially connected in a virtual medium, deciding together the upcoming meeting. So the answer to where the decision occurs is: in both spheres! They are utilizing a hybrid reality; constantly crossing the boundary between virtual and physical (this example builds upon Latour 1999a: 176-180).

Analyzing the interaction of two people is possible in the fashion outlined above. However ICT today, as shown in this chapter, represents an integral part of modern society. The average facebook user has 190 friends that he or she interacts with (facebook 2011). This represents only one form of ICT, a social network and only one type. Modern people utilize several forms of ICT simultaneously: the internet, mobile phones, social networks, email, forums blogs etc. All this creates highly complex networks and modes of interaction not easily understood, in regard to the particular consequences (Thulin and Vilhelmson 2010). This dense net of interaction further increases in complexity with regard to Couclelis (2009) *fragmentation of activity* hypothesis. All things considered there is a real need for a viable framework comprehending these complex interactions and their geographical implications. This studies intention is a contribution to the creation of such a framework. By having an ontological discussion on how Time Geography and ANT are able to incorporate and account for these kinds of situations. By outlining the possibilities and problems of both approaches and creating synthesized concepts drawing on both Time Geography and ANT then hopefully in the future a viable framework emerges, increasing understanding and insight into the workings and consequences of ICT. Next follows the theory chapter constituting a theoretical discussion on how these two concepts relate to each other.

3. Theory

This chapter constitutes the theoretical framework of the study introducing the two theories of Time Geography and Actor-Network Theory (ANT). I am aware that critics of both theories claim that both approaches do not constitute coherent theories in the traditional sense. In a sense they are correct and I will address this in this chapter, nevertheless I still choose to regard both concepts as *theories*. This study represents an ontological discussion between the two approaches. The theory chapter serves a dual purpose firstly presenting the two approaches discussed in this study and secondly demonstrating how and where they correlate or differ. This discussion originates out of Schwanen's (2007) assumptions that both theories are fairly similar ontologically. The chapter begins with outlining the material turn of the recent social sciences and how the two approaches relate to it. Followed by a brief introduction into the historical development of both approaches addressing their origin and development, this opens for a discussion about the central tenants in Time Geography. The discussion elaborates the central tenants of time and space with respect to Time Geography and ANT and their relation with each other. Afterwards the roles of are reversed, ANT's central tenants of actor and network are elaborated with respect to ANT and Time and their relation with each other. The chapter concludes with concept of change and how ANT and Time Geographic respectively describe change, before indulging into the detailed descriptions first an introduction of the general concept of the so called material turn, representing the *aether* of this study.

3.1 Material Turn

The material turn represents a recent tendency in the social science emphasizing the importance of the materiality of society. By including the materiality of nature and technology into the analytical dimension new insights of power structure or usage are gained (Bennett and Joyce 2010). A Canadian study about hydroelectricity highlighted the need to include nature and its impact on society and technology, by claiming:

"Studying the influence of rivers on the development of technical systems proves that nature does interact with technology and therefore should not be ignored" (Manore 1999: viii)

The implications of these kinds of material inquiries redefine the scope of studies in anthropology, human geography, cultural studies, museum studies or literary studies (Bennett and Joyce 2010). The material turn highlights technologies importance for society. Technology in this view represents the material dimension of society presenting a form of social glue, a repository for memory, communication, inscription and so forth reinforcing social relations (Leigh Star 1991: 32). Without the contribution of material technological artifacts modern society becomes impossible (Latour 2007). Traditional social constructivism often neglects the importance of technological artifacts (Avango 2005: 20). Recognizing this interdependence of object and subject stresses the composite character of reality, representing the main tenant of the new material turn in social sciences and human geography. The material surroundings impact the creation of reality, in that they afford, constrain and enable action (Mol 2010: 258–265). This recognition of the materiality creates a fuller picture of society as whole, including its material dimension. Understanding social implications of technological systems necessitates understanding technological systems (Latour 1996).

3.1.1 Material Turn and the two Approaches

Both approaches discussed in this study resonate well with the material turn. Hägerstrand first introduced Time Geography as an attack on the Durkheimian concept of space and time, seeing them as social categories. This makes him an early critic of conventional social theory similar to the critique of the material turn towards the majority of the social sciences today (Thrift 2005: 338). Classical Time Geography has a strong emphasis on the material aspect of reality (Schwanen 2007: 14). Time Geography claims that every action leaves an imprint on the physical surface of the earth, taking the distortions and imprints on terrestrial space as its analytical frame. This material view portrays terrestrial space as the arena wherein everything occurs (Wärneryd 2011: 139). Therefore Hägerstrand concludes "*a landscape is both a cradle and a graveyard of all creation"* (Buttimer 2007: 119). This strong commitment to materialism by classical Time Geography created misinterpretation and criticism towards the framework (Whilbrog 2011: 117). The criticism departed from a social version of reality separating social and physical causes. The material turn claims that this separation is non-existent removing the basis for this type of criticism (Latour 1999a: 176-180). ANT is a major advocate of the material turn exclusively focusing on material explanation, excluding traditional social explanations (Latour 2007: 54). Law and Hassard (1999) presented ANT as "*a ruthless application of semiotics"* (Law and Hassard 1999: 3) referring to the strong material commitment. Latour (2007) concurs, rejecting anything that "*leaves no trace, makes no difference, enters no account is NOT an agency, either it does something or it don't*" (Latour 2007: 53). Exclusively material impact receives acknowledgment in ANT, everything else is neglected.

3.2 Time Geography

Torsten Hägerstrand first introduced the framework of Time Geography in his doctoral thesis dealing with the diffusion of ideas (Hägerstrand 1953). Despite his early success in Sweden several years passed before the thesis translation into English, in fact until 1967. During that time Hägerstrand's framework matured into what is now known as classical Time Geography, that he presented with the question *What about people in Regional Science?* (Hägerstrand 1970) pointing to absence of human intention in geographical modeling.

Hägerstrand's personality traits greatly influenced the development of Time Geography and its image. A constant source of irritation to Hägerstrand himself and his readership relates to the usage of words. For Hägerstrand it implied an irritation over the inability to express his bodily way or reasoning, leading him to regularly invent new words in order to express himself. This constant usage of new terms complicated following his reasoning (Buttimer 2007: 141-145). Classical Time Geography emphasized a strong correspondence between activity and physical location in space. Championing the approach to analyze and track an individual's movement in space and time, adopting space as an analytical focus (Couclelis 2009: 1556-1559). Time Geography's notations make no analytical distinction between humans and non humans; both have life paths that extend through the time space prism (TSP) (Pred 2005: 330). This neutrality of representation elevates meetings as representing the elementary action (Hägerstrand 2009: 67). Time Geography's overarching goal represents understanding the underlying determining factors, rather than losing itself in the surface details (Lenntorp 2008: 7).

Schwanen (2007) claims misrepresentation of Time Geography is common, critics over empathize the physical aspects and labeling it as simple determinism. The research position is presented as being that of Laplace's demon. These accusations ignored that later versions of Time Geography were far more inclusive of human action and intention. Time Geography's space rather than being deterministic is greatly influenced by Deleuzian way of reasoning, accommodating for a changing reality and identity (Schwanen 2007: 9-14). Hägerstrand in his twilight voiced great disappointment over this misinterpretation of Time Geography (Pred 2005: 331). Battling these forms of criticism a great plethora of different interpretation of Time Geography arose, some are more leaning towards social interpretations some to more materialistic interpretations. This multitude of interpretation creates difficulties defining Time Geography as a coherent theory, or a theory at all. Unfortunately this deterministic stigma still remains today, (for an example look Friberg et. al. 2009).

Valid forms of criticism, described in the background chapter, do not diminish the value of Time Geography. Time Geography clearly espoused Human Geography with a geographical ethos, that wise use of time and space are important viewing them as a resource. In extension it provided Human Geography with a concrete sense of *thereness,* giving analytical strength to spatial claims and their importance (Thrift 2005: 338).

3.3 Actor-Network Theory

ANT developed out of the Sociology of Science, applying social methods to the study of science. The sociology of science represented a fruitful enterprise according to the sociologists, but the natural scientists expressed concerns about jeopardizing the objective claim to knowledge of science. Sociologist claimed that scientific facts are fabricated in contrast natural scientist claimed they are objectively true, resulting in the so called *science wars* (Gieryn 1999). ANT drew the conclusion that scientific facts are true *because* they are fabricated (Latour 2007: 90). This conclusion resulted in a radical reinterpretation of the word objectivity and social. Latour (1991) stated *We Have Never Been Modern*, pointing to the disillusion of separation between naturalistic and social causes, in a sense denying traditional social explanations. He claims "*there is no society, no social realm, and no social ties, but there exist translations between mediators that may generate traceable associations*" (Latour 2007: 114). Objectivity and social construct exist according to ANT, but they are constructed out of objects, only materiality exists (Latour 2007: 64).

ANT started with the description of *Scallops* (Callon 1986) and *Laboratories* (Latour 1983) creating networks in which actors, human or not, operated. Particular strong actors dominated these networks elevating themselves to represent an obligatory point of passage (OPP). The strong actor contributed to the stabilization of the network. As development moved on recognizing other types of networks and modes or organization the concept of OPP as the only means of stabilization became problematic (Fujimura 1996). In addition the widespread adoptions of ANT lead to the loss of the oxymoronic tension between the centralized actor and the decentralized network. The *actor-network* transformed into an unproblematic concept of social theory (Mol 2010: 254 & Gad and Jensen 2010: 64). To combat this criticism and the simplifications ANT scholars created post-ANT, a version of ANT far more inclusive and advocating a range of different concepts. The inclusion of fluid and social topology tried addressing the criticism regarding the OPP as representing the only means of stabilization (Lee and Brown 1994: 786**).** Fluid objects lie beyond network conditions making them a qualitative different mode of organization from traditional actor dominated networks (Law 2002: 100). Latour specified the meaning of the term network as *"A Network is a concept, not a thing out there, it is a tool to help to describe something, not what is being described*" (Latour 2007: 131).

This multitude of different concepts poses great difficulties defining ANT as a traditional coherent theory. It's better to think of ANT as a "*repository of terms*" (Mol 2010: 262). ANT expresses no ambition to consolidates its terms and create a coherent framework. Because ANT scholars realized the ambiguous status of ANT represents its greatest advantage.

"*The art is not to build a stronghold, but to adapt the theoretical repertoire to every new case" (Mol 2010: 256)*

Thereby post-ANT goes through great efforts retaining its inbuilt tension as a constant reminder of the complexities encountered describing material reality. Thereby it redefines the concept of theory, instead of being a concept describing the world it refuses to know in advance who the relevant actors are. This type of knowledge only results from an analysis therefore it is impossible to know in advance who the relevant actors are, according to post-ANT (Gad and Jensen 2010: 76).

3.4 Time

Below follows the first of five discussions about the central tenants of both approaches. Time represents the first; Time Geography emphasizes the budgeting of time (Dodgshon 2008: 10). Hägerstrand (2009) talks of time as a measure of change to the physical world. Time is not only a measure, is a results out of the continuation of change (Hägerstrand 2009: 218-224). Time represents a wave front continuously moving forward. This movement gives directionality to time and the wave front concept allows for specific temporal claim of: now. He nevertheless acknowledges that geographical time constitutes of a daily budget of 24 hours. These 24 hours represents a resource, needing management. This creates two different concept of time, a general time that represents 24 hours of the day in combination with a personal experience of time for the individual. Thereby the experience of time and the measure of physical change get allocated into the human experience of time. The traditional emphasis in Time Geography represented the continuous movement of hours, weeks months or years, rather than the personal experience (Dodgshon 2008).

ANT has a similar bipolar view of time, but for different reasons. ANT recognizes the continuation of time and the occurrence of events, this creates a time arrow as a sequence of events. To exemplify this dual flow of time a common occurrence might help. Every person working with computers knows they tend to create problems. While working on a computer the computer freezes, no more input is possible. The next step is to restart the computer and the problem disappears. The sequential string of events takes the following shape:

Computer usage -> Computer Problem -> Restart -> Problem gone

From this sequence of events it's impossible to tell if the restart solved the problem or the same problem could recur on a later date. The most common scenario, because humans are pattern seeking animals, is that with the belief that the restart *solved* the problem work continues. As recognized before this conclusion is a logical impossibility the only reason for this belief is that it seemed most likely. In ANT terms this belief had the most alliances. This scenario is built on Latour's notion of *representation* and *retrofitting* past events (Latour 1999a: 170). This example may appear insignificant, but the same logic applies for the discovery of Calculus, the interpretation of Nobel's Will or the Second World War. It's the victorious who write history and it's a continuous process.

ANT's concept of time is not denying Time Geography's general time. Rather it's extending it claiming the interpretation and understanding of a particular ordering of events is process dependent, the strongest interpretive network wins. Time and space are intrinsically linked in Time Geography in ANT time depends on the strongest network. Let's continue to see how the concepts of space in Time Geography and ANT relate.

3.5 Space

Time and Space are intrinsically connected inside classical Time Geography. Mårtensson's (1979) eight conditionality's create the coherent framework of Time Geography, these are:

- The indivisibility of the human being
- The limited life-spans of living and non living entities
- The limited ability of human beings and other entities to take part in more than one task at a time
- The fact that every task has a duration
- The fact that movement between two points in space consumes time
- The limited capacity of space
- The limited size of terrestrial space
- The fact that every situation is inevitably rooted in a past situation

These conditions together, see space not as an abstract concept. Space becomes something very concrete; space represents the sum of all material things incorporated within it (Hägerstrand 2009). Other interpretations of Time Geography define space differently allocating different realms of materiality and immateriality (Lentorp 2005). Faced with this multiplicity of interpretation, for sake of simplicity let's assume the first interpretation since it represents Hägerstrand's own definition and is the most commonly applied in international usage of Time Geography. In addition GIS implementations of Time Geography apply this definition of space because it corresponds to Euclidean geometry. As well as resonating better with the material turn by not introducing immaterialities represent all reasons why to prefer this definition in this particular discussion.

In this material definition of space Hägerstrand talks about a continuous web of reality without vacuums or empty spaces, he calls it *tillvarovären*, (rough translation: web of existence, Hägerstrand 2009: 96). The defining characteristic of this web represents its *bredvidvarandhet* (rough translation: next-to-each-otherness, Hägerstrand 2009: 57), no single event occurs without effecting its surroundings in some form or another, just like ripples on a pond (Hägerstrand 2009). With this view of space, time becomes the measure change of these material entities. Leading to the conclusion that space and time are interrelated, a sticky concept, interdependent of each other (Dodgshon 2008: 11).

Space is the arena where everything happens. Being in constant motion and leading to a world without levels. The distinction between material sphere and cognitive sphere is an illusion, since everything is material in Time Geography (Thrift 2006). Even human beings are material objects, strange ones indeed but material nonetheless. There is only one material world that humans only experience subjectively. Hägerstrand (2009) claims without acceptance of this tenant geographical inquiry become meaningless. This classical definition of Time Geography's space is in general accordance with the claims of the material turn.

In contrast ANT started initially with two interrelated concepts of space, one material similar to the material space outlined above and a network space. Network space defines itself as the mode of ordering networks. This notion of network is not spatial neutral because it implies the production of a particular kind of physical space with ordering of events and constellation. Network space is depended on physical space, only if an unbroken shape is maintained in physical space continuous

network function is ensured. Visiting the computer again for an analogy, a computer with internet access represents such a system. The internet represents one type of network; the computer enabling the property *access internet*. However only as long as the computer is in particular configuration is access maintained, if the computer is destroyed the property *access internet* is lost. ANT calls these configurations *immutable mobile*; immutable because a specified configuration of order is maintained, mobile because they enable access and allow for mobility inside the network space. Immutable mobiles are themselves networks, the computer is a network of circuits, transistors etc. it's a material array resulting in the functioning machine, computer. The example is based on Law (2002: 93-97).

With this definition of space similar to Time Geography there exists no macro or micro distinction. There is only a chain of connected localities; networks link together two or more locations that are apart in geographical space (Mol and Law 1994: 650). As mentioned above the OPP represents one mode of ordering a network. Where one particular actor coordinates the network, a social analogy would represent a patriarchy, dictatorship or hegemony. However in ANT there are many different modes of ordering not just one (Law 2002: 92). These different modes of order represent different types of topologies existing in n-amount of different topological spaces. Once again returning to the computer analogy: the internet represents a separate topology, the construction of the computer, the social network of the person operating the computer, the type of work the person does etc. all these different spheres represent different topologies. Mol and Law (1994) therefore claim that people's realities s*tretch* themselves over several topological levels. Inside networks exists network topology affording different kinds of interaction between topologies (Mol and Law 1994: 643-649).

Networks co-exist and may interweave with each other. However the notion of network is criticized for being binary, either actors are part of the network or not (Garrety 1997: 756). Early ANT acknowledged that everything is connected however it still largely ignored externalities of the network (Latour 1996). To accommodate for this more diffuse kind of *network* ANT scholars created the concept of *fluids* (Mol and Law 1994: 655). Fluid objects are beyond conditions of network possibilities making them a qualitative different mode of organization, a different form of stabilization. If a network emphasizes a particular actor fluids would emphasize a particular function of a network (Law 2002: 100-101). Fluids do not possess a sharp boundaries or specific components making them hard to define but also robust. Networks are created out of *immutable mobiles* while fluids are composed of *mutable mobiles* (Mol and Law 1994: 659-663). Instead of visiting the good friend of the computer as the analogy, this time the analogy necessitates a detour through Greek Philosophy. There possibly exist fluid topologies within ICT; however these hardly represent pedagogical examples to elaborate what a fluid entails, therefore the philosophical detour.
This detour constitutes the comparison of different ships. As the first examples the *Titanic* corresponds to the notion of network, because it's represents a particular ordering of space today occupying the bottom of the North Atlantic. A fluid meanwhile corresponds to the *Ship of Theseus* of the eponymous paradox. The paradox states:

The ship wherein Theseus and the youth of Athens returned [from Crete] had thirty oars, and was preserved by the Athenians down even to the time of Demetrius Phalereus, for they took away the old planks as they decayed, putting in new and stronger timber in their place, insomuch that this ship became a standing example among the philosophers, for the logical question of things that grow; one side holding that the ship remained the same, and the other contending that it was not the same. (Plutarch AD 74)

To summarize this paradox; the ships essentials are replaced one after another until none of the original components are left. The paradox asks than if this still constitutes the *same* ship? From a fluid ANT perspective the particular order or constitution of the components is irrelevant, as long as the functionality of the ship is maintained. The ship stayed buoyant; therefore it's the *same* ship. The understanding behind this example is based on Mol and Law (1994). I hope this brief departure into Greek Philosophy is forgivable in a study regarding modern ICT implementations. I included the concepts of fluids and topologies into the description of ANT's concepts of space to elaborate what Couclelis (2004) refers to when she is speaking of ANT's relative concept of space being an inspiration for Time Geography (Couclelis 2004: 53). All concepts outlined above: network space, topologies and fluids are *relative* in the sense that they depend on the objects that constitute them (Law 2002: 96).

ANT's concept of space is not free from difficulties. Because the network emphasizes the flows of actors through the network instead of highlighting were the actors are located or pass through the network, it misses the particular importance of specific places (Henke and Gieryn 2007). As geographical understanding clearly recognizes particular places have different effects on possible actions, like the utilization of technology (Oudshoorn 2012: 136-137). ANT misses particular geographical context and appreciation. Thereby this particular discussion in this study also creates a possibility where Time Geography possibly inspires ANT, since particularity of geographical space represents one of Time Geography's strong points (Thrift 2005: 338).

3.6 Actor

For the rest of the chapter the order is reversed. The remaining chapter focuses on two most important tenants in ANT and the concept of change in both approaches. The main tenants in ANT obviously constitute actor and network as the name suggests. Below follows a discussion about the concept of actor first from an ANT perspective and then Time Geography's perspective.

Founded in radical materialism of ANT the definition of actor is accordingly radical: "*an actor acts*" (Mol 2010: 255). An actor affects its surroundings, transforming, modifying or influencing it in any way or form; otherwise it's not an actor. ANT's concept of actor is not replacing the theory of action rather it aims at expanding it (Mol 2010: 255-257). With this liberal definition of actor and agency there are no logical grounds to see a difference between human or non humans, or technology and society for that matter (Leigh Star 1991: 33). According to Mol (2010) a great source of misunderstanding for the *verstehende* tradition of social science represents ANT's indifference to the definition of what constitutes an actor. ANT contents itself with the realization that an actor alters physical state, treating everything fulfilling this condition human or not as actors (Mol 2010: 225). The conventional definition of actor includes intentionality, while ANT emphasizes action caused (Gad and Jensen 2010: 61). This probably constitutes ANT's most controversial claim (Lee and Brown 1994: 775). The definition of actor differs from one network to the next. Henceforth the definition of an actor is in constant flux, every new case demands a new definition suggesting a multitude of definitions of what an actor is (Mol 2010: 257-260). This ambiguous definition has opened for a lot of criticism. In this line of criticism is the claim that ANT is supposedly only focusing on strong actors, dominating the networks with Machiavellian schemes reducing other participants to be passively manipulated by the strongest actor (Gad and Jensen 2010: 58-61). Avoidance of this type of focus on strong actors' results when the importance of weaker actors is not precluded in advance (Avango 2005: 24). Also as explained above, ANT expanded to more inclusive forms of network organization not only focusing on dominant actors.

However post-ANT acknowledges the credence of some of these criticisms. Acknowledging the differences of particular actors, not only concentrating on if they are part of the network or not. The initial treatment of actors focused on strong actors, however post-ANT recognized that just like generals; they only fight with the help of the whole army. Nobody acts alone (Mol 2010: 256).

Time Geography's definition of *actor* is less radical than that of ANT's. Time Geography usually reserves the definition of actors for intentional acting humans. However practically it makes no distinction between humans or objects (Schwanen 2007: 14). Hägerstrand (2009) in his intellectual legacy explicitly calls humans objects, intriguing ones but material objects nonetheless (Hägerstrand 2009: 81). The style of representation in Time Geography is subject neutral, both humans and objects are subjugated to material restrictions. The common adherence to physical laws highlights the awareness of Time Geography of the shared materiality of humans and objects (Thrift 2005: 338). This neutral description basis itself on the concept of constraint as a general focal point of Time Geography and one of its most distinguished accomplishments. Human activity is constrained and enabled by the structure of the surrounding space (Couclelis 2009: 1561-1557). Classical Time Geography divides into three sets of constraints on human agency (Pacione 2009: 359):

Capability Constraints: the need to sleep, eat, physical distance restriction, physical laws etc.

Coupling Constraints: time window constraints, opening hours of a shop, events need to happen in a certain order to have effect, sending an email without accessing the internet is impossible for example

Authority Constraints: laws, rules, conventions or similar

Obviously not all apply equally to different individuals. A stone, a deer or human are all experiencing different authority constraints. The stone has none, the dear experiences a few from its heard and human from a large variety of authoritative sources. The important aspect remains the ability to describe the situation in those terms for humans, animals and objects alike, regardless of their quantity. The culmination of all choices and effects an individual takes inside a defined time space are represented as a *life path* inside Time Geography. Raubal et al. (2004) argues that Time Geography lacks cognitive constrains as a form of constraints. If this is case or not is open for debate (Hägerstrand talks about limiting capacity of humans ability in Hägerstrand 2009: 20), however cognitive constraints in a practical sense are similar to authority constrains creating negative space in the *time space prism* (TSP) (Raubal et al. 2004: 249-250). The new developments of ICT, discussed in this study, are believed to challenge the absoluteness of these forms of constraints. Couclelis (2009) argues there are technical difficulties in presenting purposeful activity in virtual space using Time Geography. Her *fragmentation of activity hypothesis* claims activities are no longer strictly bound to a particular physical location, breaking with this traditional assumption in Time Geography. This leads to discontinuities activities non-specific to a particular locations. According to her no major shift in theoretical assumptions is required, but nevertheless it poses a need for recognition and modification (Couclelis 2009: 1558).

3.7 Network

The concept of network represents the next central tenant of ANT, but before indulging into the concept of network let's be clear what it's not. The term *actor-network* over time lost its oxymoronic tension between the centered actor and the de-centered network (Law and Hassard 1999: 5). The combination of the two terms opened for ANT's treatment as part of traditional sociology. The concept of an *actor-network* is not a straight forward application without contradictions, these contradictions need elaboration and accommodation (Gad and Jensen 2010: 61). In addition the definition of the word network changed due to the inception of the World Wide Web today it means "*transport without deformation, an instantaneous, unmediated access to every piece of information"* (Latour 1999b: 5). Being is the exact opposite of what ANT means by the term of network. To avoid confusion other terms instead of *network* entered the vocabulary; like rizhome or choreography (Sager 2006: 52). Latour (1999b) initially called for this change of name, however he later discarded the idea. He acknowledged establishment of *network* as a central concept in ANT and as it constituted part of the name ANT, the wording may remain as well (Latour 2007).

An important aspect of ANT is that everything requires effort, nothing is free. ANT acknowledges most actors inside networks represent mediators, where traditional social theory treats them mostly as intermediaries. Intermediaries transport information perfectly without distortion, while a mediator is always subjected to translation and interpretation. Returning to the computer internet analogy an intermediary represents the sending of emails, transferring information unedited from sender to the receiver. A mediator represents when the information is shared between colleagues to another colleague and another colleague and so forth turning into a *Chinese Whisper* representing information transfer with transformation. Recognizing this transformation and accounting for it are important tasks when creating a network, since there is always an uncertainty involved in every action (Latour 2007: 37-40). Ordering is a costly process, and the achievement of ordering is always precious. There is no transcendent order; it's a continuous process that requires maintenance at a cost (Mol 2010: 262-264). Nothing is necessary or inevitable about anything, science or technology, all constructions are historically contingent no matter how stabilized (Leigh Star 1991: 38). Recognizing that the involvement in any kind of collective effort always comes at a cost, nothing is free (Mol 2010: 263). Historic continuation of project requires constant adjustment. All these influences together create a heterogeneous project that is in constant need of negotiation to adept to the situation. Projects are modified according to the problems or opportunities encountered along their path. Failure results when these new renegotiations fail (Avango 2005: 202 & 124).

A network represents a series of elements with well defined relations between them (Mol 2010: 249). The concept of network is not abstract in ANT it refers to bonds, alliances, material entities etc. in need of establishing and maintaining (Gad and Jensen 2010: 61). Networks are in themselves constituted of networks**.** ANT treats technology as such a network, representing networks inside networks (Law 2002: 93). In the computer example the computer represents a separate network, necessary for the internet as a higher topological network and so forth, constituting different topologies, as networks inside networks. For reasons of simplification and further network building ANT claims that lesser order of networks are subject to *black-boxing* and treated as single entities (Avango 2005: 164). The user of a computer does not have to know how the computer is functioning to be able to use it. From the point of view of the user the computer represents a black box. Properly black-boxed these entities become immutable mobile, immutable in the sense that they retain their shape and form, and mobile inside the network. This creation of immutable mobiles turns mediators

into intermediaries. In a network distance is not metric; it's determined by semiotic patterns. The higher the amount of overlapping networks links the closer two entities are inside network space. This creates heterogeneous networks existing in different topologies (Mol and Law 1994: 649-652).

In the computer example the connection between actor and network assume different relations. Imagine a group of computer game developers discussing how to program a new computer game. They are debating how to create the particularities of the network of a new computer game. They treat the *actor* of electricity as a black-box, ignorant of its production and functioning. As long as the supply is maintained neither does this matter for their particular network of game design. Electricity also became an immutable mobile inside the network of computers because each computer needs it to operate, its flowing from one point to another being mobile in this sense. Electricity is immutable in the sense that only a narrow band of voltage is suitable for the computers and in extension the network to function. The interdependence of actor and network becomes apparent when electricity fails, because along with it the computers fail and their plans for the game. This example illustrates the interdependence between actor and a network, it's an extension of an example used by Mol (2010: 258). Furthermore it illustrates why ANT is particularly interested in failures or controversies. In times of conflict black boxes are opened and their inner workings surface. In the above example this corresponds to the power company isolating the source of failure systematically checking the components of the network until the error is found. By doing so they account for all the components of this formerly black box, this allows outsiders to understand its function. To recapitulate form before "*A Network is a concept, not a thing out there, it is a tool to help to describe something, not what is being described*" (Latour 2007: 131). According to Latour (2007: 132) a network is:

- a point-to-point connection that is being established, which is physically traceable and thus can be recorded empirically
- such a connection leaves empty most of what is not connected
- this connection is not made for free, it requires continuous effort

The concept of network outlined above in combination with the cost of ordering results in a realization that: the world is getting bigger (Latour 1999a). Try recalling the example of email vs. Chinese Whisper, the email usually represents the *easier* solution to convey information because information is transferred without deformation in comparison to colleagues telling each other. According to Latour (2007) this is the conclusion that the traditional social science draw. However ANT teaches that for the email to be a *simpler* form of information transfer than person to person communication; a whole network of computers, email providers, electricity, teaching people how to operate computers, designing computers etc. is required before one even can consider sending an email furthermore these established networks need maintenance. According to ANT intermediaries are at the end of a long chain of processes not at their start. Turning mediators into intermediaries is a highly complex and costly process that needs maintenance. In this the sense the world is getting bigger by getting more and more complex; ANT is a reminder of this fact. It's not that ANT's picture is inherent better than other representations. Rather a description contemplating the impact of ICT on society needs to account for everything including technology when describing the effects of technology. Actors inside the network have the luxury of black boxing, for understanding of networks black boxing is a deadly sin (Latour 1996).

The notion that networks require ordering of particular events and event structure resonates in Time Geography's concept of *project*. In Time Geography a project refers to meaningful human activity, in the choice of a life path. A project is not defined by its temporal extend, rather by the ordering of events necessary to achieve a particular goal. This recognition of human intention in choosing the shape of a life path inside Time Geography contradicts the claims of mechanistic tyranny or determinism. The ordering of events is important to complete a project; Time Geography calls this process an *activity bundle*. The structure of an activity bundle is of vital importance to the success of an event (Couclelis 2009: 1556-1561). The sequencing of events represents a non-random process, they are determined by; resource availability, past events, possible future intentions etc. (Svee et al. 2009: 2). Combined with the concept of constraints this represents a difference between ANT's notion of project. In ANT success of a project is *only* depended on the network structure, while in Time Geography failure or success also depends on external factors. Thereby external factors are possible to assume such overwhelming force rendering a project impossible. ANT lacks this notion of impossibility by outside factors.

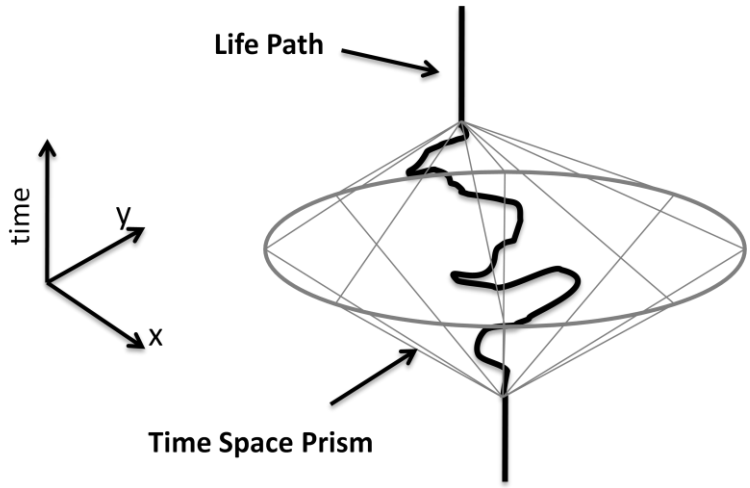

Figure 2: Time Space Prism, source: author

Capability and coupling constraints define a maximum limit to the extent of an individual's possible movement space, during a certain period of time. As seen in Figure 2 a time space prism (TSP) corresponds to the encapsulation of all possible activities. Inside the TSP activities assume different qualities: fixed activities are hard to relocate, while the relocation of flexible activities is less difficult. Activity realization occurs only when the activity intention and location intersect inside the TSP, creating a Time Space Station (TSS). TSS represents physical locations that contain the resources available for enabling different activities; occupation of a TSS becomes a necessity for the conduct of an activity (Raubal et al. 2004: 248). The totality of TSP and TSS represent an arena, offering all the necessary elements for a certain project to occur (Pacione 2009: 359).

3.8 Change

The last part of this theory chapter represents a discussion how change is accomplished in both approaches. In ANT change correlates to actors and their relation to the network. These concepts correlate to navigating and construction of the network thereby achieving change. ANT calls these: *translation, problematization, interessement, enrollment, mobilization, alliance building* and so forth (Mol 2010). Latour (2007) suggested the common term of *network-work* for all these different concepts. A further suggestion by Mol (2010) is *tinkering,* because it implies a continuous process making small adjustments. Unfortunately the toolbox of ANT as a *repository of terms* lacks common agreement of definition, yet alone consolidation of the terms. Instead a consisted string of new terms differing in usage arises constantly. This ambiguous nature of ANT's concepts clearly opens up for confusion, making it hard to properly criticize ANT (Mol 2010: 264-266 & Gad and Jensen 2010: 58). The concepts described below represent the most common concepts in use.

A key concept in ANT is translation (Gad and Jensen 2010: 57). The capability to translate others interest in a way that these correlate to one's self-interest, is an essential part of network construction (Avango 2005: 66). For technology to succeed: attracting financiers, builders and users alike translating their interests into one unified network is necessary (Mol 2010: 259). Translation seizes on the actors uncertainty of understanding a particular situation. By presenting a different mode of explanation, coupled to interests of the translator changing the understanding of the situation for financiers, builders and users accordingly (Sager 2006: 50). A classical case in ANT is when Latour (1983) paraphrases Pasteur in claiming: *Give Me a Laboratory and I will Raise the World.* He shows how Pasteur translated the farmers' interest to fight anthrax into backing his own scientific effort. Without the farmers' self-interest of fighting anthrax Pasteur's project couldn´t succeed, as their backing represented his leeway. Pasteur convinced the farmers the only way to fight anthrax represented backing his research, which in turn created a solution to combat anthrax. He established himself as a waypoint necessary for the farmers' project of fighting anthrax to succeed; he became an OPP for the farmers' intention of fighting anthrax (Latour 1983). A modern analogy represents the developing of role-playing game Diablo III. It's the successor to Diablo II however 12 years separate the release of Diablo II to Diablo III, which represents an eternity in the video game world. The only explanation why a video game developer has the unique possibility of a 12 year development process is because Diablo II had a massive fan base among gamers (Washington Post 2012). Interpreted from an ANT perspective Blizzard Entertainment (the development company behind Diablo I, II and III) represented an OPP for the fan base to play Diablo III. Without this continued support from the fans no company, even Blizzard, would ever dare taking on such a long development process with unsure benefits at its end.

Having said all this, translation is not a problem free process. The translation of interest may violate the integrity of the person subject leading them to resist integration into the network, if not done by the means of coercion (Leigh Star and Griesemer 1989: 406). Translation is problematical since the introduction of the *laboratory to the farm* may not be welcomed by the farmer (Oudshoorn 2012: 133). Latour makes room for this form of criticism by acknowledging the indeterminacy in a project, giving the need to adapt for both parts (Latour 1996). Nevertheless translation remains a useful concept to illustrate network activity. Coupled to the notion of translation are the concepts of alliance building, mobilization and coordination. If translation is successful alliances are built that help to further the project. However this building of alliances is a

give and take modifying the original project to satisfy both (or more) parties' interests, thereby the interests are usually not violated (Avango 2005: 21 & 100). *Coordination* refers to the effort to keeping the network working, coordinating the different actors' efforts. This indicates that the actors retain their integrity allowing coordination, not just becoming cogs in a draconian machine of domination (Sager 2006: 50). Mobilization refers to the mobilizing of actors of the network to face outside or inside stress to the network (Avango 2005: 21). As made clear above, these are not the only terms in ANT describing these kinds of processes other concepts like: articulation, enrollment, or interessement to just name a few also relate to the network building process and change. Nevertheless these terms overlap considerably in what they are trying to describe. So the importance is not the terms in itself, but rather the mechanism of network-building and maintaining that they are trying to elaborate.

In Time Geography change depends on the structure of the project and the constitution of the arena. Time Geography posits meeting as the fundamental action. For physical objects these meetings are determined by the constitution of the surrounding space, i.e. arena. This arena enables and restricts certain meetings, like a ball rolling down a slope. The slope enables movement down-hill simultaneous preventing backwards motion uphill, thereby enabling and restricting (Hägerstrand 2009).

For Humans these meetings represent a conscious choice, enabling humans to choose their destiny by influencing their projects with conscious actions (Couclelis 2009). These two types of meetings one for objects and one for human action are highly dependent on each other. Humans require physical meeting in order to allow for conscious choice. Hägerstrand (2009) gives the example of a child chasing a butterfly; he claims the division necessary to ask if the action represents a conscious activity or physical activity neglects the physical shape of the situation. The situation necessitates physical ground for the child to stand, air for the butterfly to fly, contrast for the child to see butterfly, a sensation on the child's retina to see butterfly etc. etc. In reality even the so called conscious action are constituted of a plethora of infinitesimal amalgamate of actions. Therefore he concludes to ask if the action was conscious or unconscious is irrelevant. The best alternative represents the acknowledgment of the totality of space and allocates different actors different degrees of freedom. Therefore the demarcation of the event results not in a bifurcation into two mutually exclusive events, but rather an increasing gradient of possible degrees of freedom of choices. The butterfly subject to the reflex of flight probably has little choice in fleeing from the impending doom of a crushing child's hand. The child triggered by impulses probably has a higher degree of choice than the butterfly, but nevertheless abides the impulse *chase butterfly.* With this concept change depends upon the possibilities created by the total constitution of space, humans being a part of this constitution (Hägerstrand 2009: 115-119).

The difference between the two concepts represents the conceptualizing of change. ANT conceptualizes change as the result of agency from actors within the network. While Time Geography sees change as property afforded by the constitution of the *allrummet* (Hägerstrand's (2009: 76) term for the totality of all space) enabling and constraining certain changes. This concludes the theory chapter. Let's move on into the methodology chapter to elaborate the selection and analysis of the case studies.

4. Methodology

The methodology of this study is highly dependent on the selection of the three case studies that create the foundation for the analysis. All three studies extended Time Geography to the virtual sphere of Information and Communication Technologies (ICT), building both a framework and methodology. Included in this chapter is a detailed description on the selection process, giving insights into how representative these three studies are for the research field of Time Geography dealing with ICT. The chapter continues with a description of the analysis a qualitative reading of the studies, inspired by content analysis. The walkthrough of the methodology elaborates the particular modification to content analysis. The modification represents that one text creates two interpretations; one from the perspective of Time Geography and one from Actor-Network Theory (ANT). This creates the basis for the analysis of the two approaches. The methodology chapter concludes with a brief discussion of the ethical considerations and the possible advantages and drawbacks of this kind of inquiry.

4.1 Search Constraints

Before the onset of the search for case studies a preliminary subject search (Appendix 9.1) established the main areas of inquiry for Time Geography and ANT respectively. A lack of convergence of study areas represented a difficulty in comparing the two approaches on the same subject. Summarizing and interpreting a single study from both approaches represented the next best solution, therefore the choice for one study resulting in two interpretations for a possible comparison. In addition the examples given by Schwanen (2007), Raubal et al. (2004) and Couclelis (2009) represented not exclusively focus on ICT, but mainly they lacked necessary detail depth for an ANT interpretation. All three works represented journal articles.

In face of this situation the analysis material delimited itself to three studies, only dissertations or research reports received inclusion in the selection process. The reasoning behind delimiting to only three studies is because every study faces issues of manageability; the feasibility of a proposed framework is integral to the success of any study. This particular study represents my master thesis in geography at the University of Gothenburg. The writing of this thesis corresponds to one semester, representing roughly 20 weeks of full time study (University of Gothenburg 2012). To ensure manageability inside this timeframe, the analysis needed to delimit itself accordingly.

The selected studies constitute dissertations and research reports. Such studies received preference over journal articles because of the high detail requirement necessary to conduct any ANT study (Latour 2007: 133). The more stringent space requirements for journal articles provide less vital data. This constitutes no major problem for the summarization of Time Geography while ANT emphasizes different aspects. The shorter format possibly omits information vital to the interpretation from an ANT perspective. Dissertations and research reports usually receive greater space for presentation. Therefore the focus on this type of presentation represents an attempt to minimize this problem.

The temporal constraints for the search represented the year 2000. The rapid expansion of ICT and its implementation is the reason behind the temporal restriction to 2000 - 2012. Continuously development and implementation of ICT changes society accordingly. With this constant stream of innovation there is a real risk that older studies become dated, resulting in the chosen period. Next follows the actual database search and selection process.

4.2 Selection Criteria

A search of different databases with *"time geography"* as the search term represented a first selection of possible studies. Using only one search phrase ensured the inclusion of the largest sample size possible. A natural constraint for the study was the timely access to the sources; therefore the selection process omits studies not available online. Identification of major database represented the first step for the database search. The selection of the databases depended largely on language restriction of the author. The possible languages represented English, German and Swedish as the author is fluent in all three. Included in the language spectrum was Norwegian and Danish as their structure is fairly similar to Swedish and possible to understand in writing with good knowledge of the Swedish language. A further inclusion represents Finish, because the second official language of Finland is Swedish. Translations into the most common languages of the respective country specific database served to broaden the search to five other languages than just English. Time Geography translates to: "*Zeitgeographie*" (German), "*tidsgeografi*" (Swedish), "*tid geografi*" (Danish and Norwegian) and "*aika maantiede*" (Finish). This broad selection process included the entirety of all published Time Geography works in these databases. Below follows a presentation of the international databases identified and searched:

- **ProQuest:** being a British based online database for major publications in English. The database largely represents British and American publications in a wide range of academic fields. (http://www.proquest.co.uk/en-UK/)

- **WorldCat:** being an American based online database for major publications in primarily English. The database largely represents publications from the English speaking academia like; Australia, Britain, Canada, USA and more. (http://www.worldcat.org/)

- **Karlsruher Virtueller Katalog**: being a online database created by the *Karlsruhe Institute of Technology* representing a wide arrange of other German speaking publications, in addition to other international databases in other languages. The searchable countries represent: Germany, Austria and Switzerland for the German speaking publications in addition to Australia, Denmark, Finland, France, Great Britain, Israel, Italy, Canada, Luxembourg, Netherlands, Norway, Poland, Portugal, Russia, Sweden, Spain, Czech Republic, and USA. It also includes online bookstores like: abebooks.de, Amazon.de, Booklooker.de, and Libri.de. (http://www.ubka.uni-karlsruhe.de/kvk.html)

The search extended to country specific databases. These represented:

- **British Library Integrated Catalogue:** being the online database of the British Library, representing publications in English. (http://catalogue.bl.uk)

- **SwePub:** the official database of all major dissertations published in Sweden, including publications in both English and Swedish. (http://swepub.kb.se/)

- **bibliotek.dk:** being the online database of the Danish Library, representing publication in Danish, English and Swedish. (http://bibliotek.dk/)

- **Bibsys**: being the online database for the Norwegian Library, representing publication in Norwegian, English and Swedish. (http://www.bibsys.no/norsk/)

- **Linda:** being the official database for all major dissertations in Finland, representing Finish, English and Swedish. (http://linda.linneanet.fi)

The last extension to the search for possible studies represented the inclusion of databases of a few major Swedish universities. There is no particular ordering or selection process why just these university databases received inclusion. Rather it represented a further ad hoc attempt to broaden the search. The university databases searched included:

- Linköping University
- Luleå University
- Lund University
- Örebro University
- University of Gothenburg
- University of Stockholm
- Uppsala University

The database search focused on dissertations and the research reports. Appendix 9.2 represents a statistic over the obtained search results. A manual analysis represented the next step in the selection process. Figure 3 represents a visualization of a flowchart that summarizes the manual relevance evaluation.

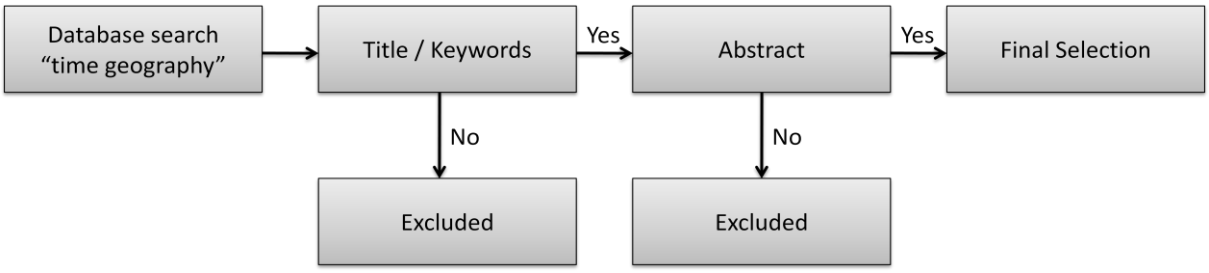

Figure 3: selection flowchart for the manual selection of the studies, source: author

The initial database search for the search term *time geography* represented over 2000 hits. From these 2000 hits approximately 50 studies continued to a detailed reading of the abstract. From the 50 studies 12 remained for the final selection process outlined in 4.3. The 2000 search results were first analyzed according to their titles and keywords relating to ICT. Correspondence to concepts like Internet, telepresence, ICT, mobile phones, Information Age, E-commerce, virtual and similar key concepts initiated a detailed reading of the abstract. Negative correspondence resulted in exclusion. The reading of the abstracts revealed the utilization of the concepts. Incorporation into the final selection only occurred when the studies employed the above concepts in a context that explored the utilization of ICT. The remaining studies created a list of twelve possible candidates that represented the final selection. Below follows an elaboration on this final selection.

4.3 The Final Selection

The main reason for the selection of the three studies from the final selection list (Appendix 9.3), besides fulfilling other requirements outlined below was that all three represented attempts at building a conceptual framework that extends Time Geography to explain the hybrid realities of ICT utilization.

The final selection of studies represented a collection of twelve studies that utilized Time Geography in one form or another relating to ICT. All studies expressed awareness of the complexities involved in understanding ICT. Stressing Time Geography's need of extensions when applied to hybrid realities, which result from the combination of physical and virtual reality. All expressed a collective belief that it is possible to describe these hybrid realities in an extended Time Geographic framework.

The criteria for further exclusion constituted whether ICT understanding represented the main focus, if not such studies received exclusion. The excluded studies related to ICT but their main focus corresponded to (several studies had the same main focus):

- transportation
- education
- political and urban identity
- attitudes towards ICT
- disaster preparedness
- creativity of scientific communities

Conveniently after all exclusion criteria, only three studies remained. So far the description focused mainly on reasons for exclusion, let's now reverse the gaze and focus on why the three selected studies deserved inclusion. Below follows a short presentation of the selected studies, alongside additional reason why I believe these studies represent good possible candidates to speak for general trends in Time Geography. The three selected studies were:

Case A: Pultar

The Role of Geography in Social Networks: CouchSurfing as a Case Study
by Edward Pultar
from: The University of California, Santa Barbara, USA
published: 2011

This doctoral dissertation investigates the impact of online social networks on people's behavior. The internet represents an important adaptation of ICT in Sweden (as seen in Figure 1) and worldwide. In combination with the importance of online social networks (Urry 2003) this study clearly contributes to relevant field of knowledge about social networks. The study analysis the location based social network (LBSN) of CouchSurfing (CS) as a case study. Giving insights in the functioning's of social networks and their effects on physical travel.

An additional factor corroborating the selection of this particular thesis represented the scientific environment of the author. The author of the dissertation Edward Pultar published a number of papers on the same subject together with the geographer Prof. Dr. Martin Raubal, who works part-time at the same faculty being probably an advisor to him. Raubal actively works with the modeling of Time Geography in a GIS environment, having published several papers on the subject. Raubal also represented one of the officials that approved this and other dissertations at the University of California (ETH Zürich 2012, he works both at in Santa Barbara and Zürich) which strengthens the credibility of the dissertation.

The next selected study constituted also a dissertation:

Case B: Yin

Human Interactions in Physical and Virtual Spaces: A GIS-based Time-Geographic Exploratory Approach
by Ling Yin
from: The University of Tennessee, Knoxville, USA
published: 2011

This particular doctoral dissertation explores the combination of virtual and physical realities in the usage of phones and social networks. The dissertation explores two different approaches to the modeling of social networks, one location based approach and one individual based approach. The individual approach focuses on activity, thereby being in direct correlation to the *fragmentation of activity* hypothesis by Couclelis (2009: 1559-1560), she claims that only an individual activity focused approach is capable of handling the emergent complexities of ICT. The comparative approach contributes by empirically testing the viability of Couclelis claim.

The scientific environment of the author included her thesis supervisor the geographer Dr. Shih-Lung Shaw; who according to his homepage specializes in *"effects of information and communications technologies (ICT) on human activity and travel patterns, transportation planning and modeling, time geography, temporal GIS, and GIS for transportation*" (University of Tennessee Knoxville 2012). He published eleven articles in the field of ICT and Time Geography constituting a respectable figure in the field of Time Geography. All this strengthens the credibility of the dissertation.

The last study selected represented a research report:

Case C: Baker

Dynamic Trip Modeling - From Shopping Centers to the Internet
by Robert G.V. Baker
from: The School of Human and Environmental Studies, University of New England, Australia
published: 2006

This study attempted the creation of a mathematical model based on the tenants of Time Geography to explain physical movement to and from shopping centers and internet traffic. In addition to the theoretical modeling large empirical datasets were utilized to test the modeling. This extensive empirical data in combination with the theoretical modeling corroborates the findings of this study.

Associate professor Robert G.V. Baker, according to his webpage published forty refereed journal articles and book chapters. He was elected Vice-Chair of the International Geographical Union's Commission on Modelling Geographical Systems in 1996 as well as for Chair in 2005 and furthermore he was appointed to the editorial boards of two international journals since 1998: The *Journal of Regional Science* and *Journal of Geographical Systems* represent a few among many of his credentials. All these credentials establish him as a respectable figure within the area of geographical modelling (University of New England 2012), creating confidence in the skill of Baker as a researcher strengthening the credibility of the research report.

These three studies represent three case studies constituting the basis for the analysis conducted in this inquiry. The whole structure of the selection process combined with the similarities between the final selection of studies corroborates my belief that these studies addresses general trends in Time Geography. In addition all three studies attempted creation of a Time Geographic approach able to explain ICT's impact on society. Giving credence to both my assertion that Time Geography is in need of extension and that such an endeavor is meaningful.

4.4 Analysis

The analysis took the shape of a qualitative reading of the case studies, being greatly inspired by the use of content analysis (Bryman 2008: 273-293). The implementation of content analysis applies only to one half of the study on which I will elaborate below. Nevertheless content analysis provided a point of departure, on which the operationalization of this methodology extended. The operationalized research questions applied to the texts are as follows:

- *What was done in the study?*
- *Which concepts is Time Geography using to describe telepresence by ICT?*
- *What difficulties is Time Geography facing when describing telepresence by ICT?*
- *How would Actor-Network Theory describe telepresence by ICT in the presented scenarios?*

These questions allowed for the creation of text extracts. The condensation of these text extracts created categories. All categories together allowed construction of a summary of the analyzed texts.

Below is an example how this process of condensation proceeds from text extracts to category:

"The hosts provide museum recommendations, sacklunches, and travel tips for the area increasing the traveler's mobility, efficiency, and overall cultural experience" (Pultar 2011: 26)

Pultar takes this occurrence as representing mechanisms how the shape of the time space prism (TSP) transforms due to interaction with different actors. This type of argument occurs at several locations throughout the study. Thereby this particular text extract represents one of the text extracts that represent my constructed category: *mode of altering the shape of the TSP* for Time Geography. Analyzing the same extract from an ANT perspective deviates from traditional content analysis. This deviation occurs because the concept of ANT is introduced into the text, not being utilized by Pultar himself. Nevertheless an ANT description condenses the same text extract into the category: *creation of new alliances*, increasing the actor's relative strength and ability to coordinate the network.

The purpose of this example was to elaborate how the same text extracts yielded two different interpretations. The interpretations for Time Geography and ANT are not always derived from the same text extract; however this is the basic logic that is employed to analyze the studies. Figure 4 depictures how this process translated to the entirety of the whole study. The result section represents the summarized discussion of the extract, categories, etc. The main focus of this section lies in the analysis of how the authors apply different approaches and how they relate to telepresence and not how I arrived at them. For reasons of pedagogical presentation I choose to largely omit citations and page references in the result chapter. The chosen presentation style resonates better with the aim of the study in discussing how the concepts relate and not focusing too strongly on their creation.

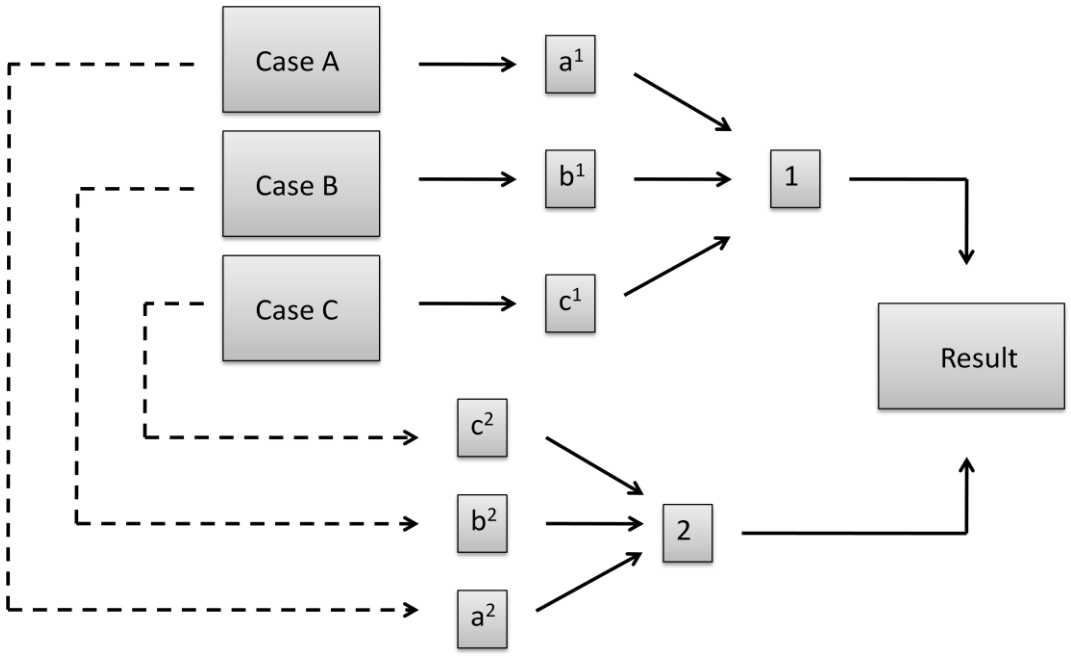

Figure 4: illustration of the procedure how the studies were summarized and compared, source: author

Nevertheless to elaborate how the extract, categories summarizations etc. were created a quick walkthrough follows now. The process started with the reading of the texts chosen for the study (Case A, Case B and Case C). The information in the text condensed into fewer and fewer categories according to the logic outlined above. The condensations together created summarized representations of the texts (a,b and c), using central concepts from Time Geography (Path 1) and ANT (Path 2) respectively. The three individual summarizations generated a general approach. These two general approaches (1 and 2) served as the foundation for the analysis on how the notion of telepresence and ICT is handled for Time Geography and ANT respectively. This procedure strengthens the argumentation by not basing the argument on only one study, but on a conglomerate of all three studies.

The analysis utilized a separate set of research question addressed to the generalizations of the text of both approaches. The operationalised analysis questions applied to the texts are as follows:

- What were the similarities between the utilization of Time Geography in all three studies?
- What were the differences between the utilization of Time Geography in all three studies?
- What Time Geographic concepts were used and extended upon?
- What ANT concepts can be implied?
- What other approaches were utilized in the three studies?
- How was the notion of telepresence by ICT handled in different studies?
- How does Time Geographies mode of explanation compare to ANT's?

These questions represent the basis for the analysis. The understanding gained by answering all these questions enabled answering the overarching research question:

- What concepts does a synthesis of Time Geography and ANT create?

The synthesized concepts depart both from the understanding of the theoretical background and the knowledge gained from the case studies. The great advantage of utilizing this kind of methodology outlined here is the possibility to move freely between the different levels. By keeping reference of each individual step of gradual increasing theoretical generalization a clear chain is created. Figure 5 visualizes this *chain of reference*.

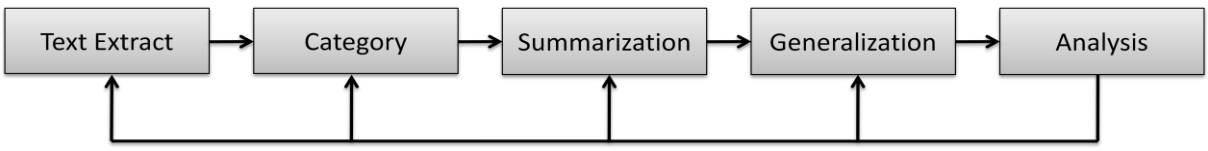

Figure 5: chain of reference, source: author

For simple presentation purpose the chain is presented as a single line, in reality it presented a pyramid structure, with several text extracts as its foundation moving higher through few and fewer theoretical generalizations. Several text extracts create a category which in their turn creates a summary. The three summaries create the generalizations that represent the basis for the analysis. By keeping reference one can freely move back and forth at will between these different stages validating any particular concept and it correspondence with the original text. This is similar to

content analysis in creating a very transparent methodology that is always traceable back to the original text, creating closeness to the text (Bryman 2008: 288). However this method is different to content analysis in that the construction of the two general approaches differs. Time Geography is explicitly used in the texts, while the usage of ANT is my own interpretation. Because the ANT generalization is based upon my own interpretation a further dimension is introduced, namely potential lack of understanding or misinterpretation on my part. This creates an ethical dimension to the reading and analysis. Therefore I will give a brief ethical discussion about this kind qualitative enquiry presented here, before I proceed to present the result of the study.

4.5 Ethical Considerations

The following analysis is derived from the author's understanding of the literature of Time Geography and ANT. The same applies to the representation of the comparison and all necessary parts. Every step involves higher degree abstraction by the author; this creates the possibility of involuntary introducing subjective interpretations. This may or may not lead to biases in the research at hand. Therefore the closeness to the text becomes vital, as described with the chain of reference. This closeness allows for a return to the original text to verify that the derived argument is in accordance with the text. This approach reduces deviation of the interpretation because the interpretation is potentially only one level of abstraction from the original text. Applying this type of methodology reduces the risks of misinterpretation and misrepresentation.

In general the possibility of introducing subjectivity shouldn't infringe on scientific inquiry, because according to Collins (1981) theoretical doubts of every scientific inquiry always outweigh justifications. In most cases it's preferable to conduct the inquiry regardless, because at completion of the study the new knowledge gained transforms the basis for argumentation (Collins 1981: 216-217).

Furthermore there is no way around this kind of subjectivity; all social research is subject to this form of subjectivity because it is a human endeavor (Collins 1981: 216). In fact sociologist of science recognized that even the supposedly objective natural sciences are subject to this kind of subjectivity (Leigh Star 1991: 31). By being a subjective enterprise that is relying on the interpretations of human researchers (Shrader-Frechette 1994: 98-100). Therefore the idea that methods yield clear instructions for the researcher leading to objective results seems highly doubtful (Gad and Jensen 2010: 73). This subjective nature of every human endeavor creates the realization in the field of theory of science that "*there is no better way*" (Latour 2007: 127) of doing science. The only possibility left is acknowledging the fact and embracing it opening up for a relativistic science (Latour 2007). This realization deviates from the absolute version of truth believed to result from science. After abolishing this absolutistic version a relative version of truth remains. Science represents an open-ended endeavor not fully determined. However science can deliver certainty and truth, if only in a relative sense based on usefulness of the concepts applied (Chalmers 1999).

5. Case Studies

This section is a presentation of the analyzed studies. A short summary of the studies introduces the subject of the studies, following a brief walkthrough of the theoretical assumptions concluded by a presentation of the result from a Time Geographic perspective alongside an Actor-Network perspective. Below follows the first summary corresponding to Case A:

5.1 Case A: Pultar

The Role of Geography in Social Networks: CouchSurfing as a Case Study
by Edward Pultar
from: The University of California, Santa Barbara, USA
published: 2011

This study (Case A) is an inquiry by Edward Pultar to understand location based social networks (LBSN) and his attempt to construct a framework based upon Time Geography explaining physical and virtual interaction. He lists five study objectives, the main objectives represents:

- The creation of a conceptual model capable of description of multi-network spatial behavior. The intrinsic connection and interdependence of physical and virtual presence represents the foundation of this objective.

The remaining objectives represented:

- geographical visualization of the approach trough GIS applications
- social network data mining,
- demographic effects and
- measures of social capital inside LBSN

His employment of Time Geography in this novel context of LBSN marks an acknowledgment of the interconnection between physical and virtual spheres, resulting in recognition of new types of constraints.

Pultar argues that the choice of the LBSN of the couchsurfing.org project (CS) as a case study, allows for unique insights because of the composite character of the project, being a virtual network allocating physical accommodation to its members. The CS network created in 2004, posts more than 2.5 million members from over 200 different countries representing more than 300 different languages (as of the time of the study, 2011). CS being an internet forum where members provide each other with free accommodation, representing a place for the traveler to sleep: usually a couch, floor, futon bed or similar. Building a network of good will, where favor and return is not done to an individual but the collective as a whole. A reference system based on other members references, allows an individual to assess potential host or guest and their trustworthiness prior to meeting them in person.

CS functions by guests contacting possible hosts via the inbuilt couch request system, similar to an email service. The potential guest receives a more refined selection of hosts by specification of search criteria like age and gender. Once the search is made, a further selection is possible due to detailed information left by the user on their profiles, about life philosophy, outlook on life, type of sleeping arrangement and so forth. Together with references left by other users that previously meet the potential host; all these represent criteria for the choice of a potential host. Once a particular host is chosen the next step represents the establishment of contact, utilizing the inbuilt message system. From this exchange of information both parties decide if they want to meet in person. Upon acceptance of the request the host, often a resident at the desired location, provides accommodation for the guest. After physical meeting, both separate again and return to the virtual contact, by leaving references about the experience on the other person profile, becoming a further reference on the person profile. Members often start by utilizing the network only for hosting or being a guest but later engage in both, as it is necessary for the network to succeed. The main purpose of the network is to facilitate F2F physical interaction between members, blending physical and virtual social networks. Pultar uses two example cases of a typical utilization of CS to describe his modified version of Time Geography.

In addition CS represents a new type of tourism instead of visiting traditional tourist destinations individuals actively search contact with the population of the placed visited. Thereby according to Pultar leaving there *comfort zone* and indulging in a different kind of cultural experience. This new tourism is greatly facilitated by the employment of such networks like CS. Making it an example in how virtual data network and social networks link with physical presence enabling transportation, cultural exchange and more. Pultar sees these new types of combination of physical and virtual reality in need of visualization of how individuals utilize multiple networks at once. This utilization of both realities creates hybrid realities. Pultar attempts visualization and analysis of these in the here presented study. The understanding of the spatial relation of these hybrid realities necessitates the recognition of the intrinsic connection between the virtual and the physical. Pultar exemplifies this particular style of visualization and presentation on particular examples, below follows the first of two of these particular examples.

5.1.1 Female American Traveler

A young woman expresses great desire for a trip to experience the different European cultures. Utilizing the internet and CS she is searching for cheap plane tickets and accommodation. Having flexible itinerary and minimizing lodging fees by using CS allows her to conduct the trip, at for her a reasonable cost. The economic threshold for the trip is greatly lowered by utilizing CS cost free lodging and the cheap airplane tickets. She plans spending a week in the Netherlands, but after three days decides to visit Antwerp, Belgium. By utilizing the CS network she finds a suitable host in Antwerp giving her a unique food, musical and historical experience due to the local expertise of the host. Obtaining discount airline tickets from a previous host booking a flight to Brno, Czech Republic. She contacts multiple hosts, but no specific plans regarding accommodation are confirmed prior to the flight. At the airport one hour prior to departure plans solidify via mail. Leading to a two day stay in Brno with a particular host, that shows the castles, casemates (chambers in fortresses), and the college campuses. Upon realizing the relative closeness to Vienna, Austria she spontaneously decides to visit Vienna. Due to the short term decision she is only able to record a few phone numbers of potential hosts before departure; upon arrival she calls several hosts out of which one accepts her

stay. The host provides her with a place to stay for the next nights, also providing museum recommendations, sack lunches and travel advice easing the use of public transportation. Continuing northwards she stops in a small Czech town, wandering into a local festival meeting a friend of a previous host providing her with accommodation. Accompanied by a member of CS she conducts a short excursion into a Polish national park for a few days. At the end of her trip in Poland, a host gives her another unique experience as he is an aspiring tour guide showing her the city of Krakow. Overall she claims that she had a unique experience meeting and experienced a great diversity of people and places.

5.1.2 South American Professor

The second example constitutes a South American professor attending a conference in Barcelona, Spain. There he is giving a presentation about a paper he published. Never prior visited Barcelona or Spain he decides to spend a few days before and after the presentation there experiencing the culture. The traveler discovers a CS host in the same age span as himself, who is a longtime resident of Barcelona. They initially exchange information via the use of e-mail planning activities that are convenient for both parties, leading up to their meeting in person. The host takes the guest to local museums and restaurants not mentioned in the professor's travel guide, pleasantly surprising the professor to experience this side of Barcelona. After the conclusion of the trip, both parties stay in contact hoping to reverse the roles of guest and host in the near future.

5.1.3 Case A: Time Geography

The major difference between the two travelers described above is the constraints the travelers face. While female traveler is relative free from constraints, allowing her to change her itinerary at will. The professor is more restricted and has a higher need for planning. Pultar creates a GIS application which lets him visualize the physical and virtual paths of the individuals. There he maps virtual and physical presence unto the same geographical location using different colors to differentiate between the two. Pultar derives this mapping process from of Time Geography's constrains:

Authority constraints: become apparent when a host gives a guests information about opening and closing hours of local sites, suggesting sequencing in visiting for time optimization. Or determining when an individual is able to dine out or movement by plane, bus or train.

Capability constraints: are apparent when the hosts or guests share local or international transportation, by providing means of transportation or access to means of transportation. This is affecting the traveler's velocity and the resulting route, due to the available forms of transportation.

Coupling constraints: apparent when physical meetings occur; the guest and the host convergence in time and space or between the traveler and any other form of transportation. Virtual presence has less coupling constraints than physical presence. But both are necessary in the described cases for the stay to occur. In a step by step process the presence shifts from virtual to physical presence, adhering to the more stringent physical constraints like synchronous presence and location convergence.

In addition to constraints he applies the concepts of *fixed vs. flexible activities* and *potential path areas* and *prisms*. If a Traveler intention represents a visit to a theme park, if not specified which theme park the schedule remains flexible for location and time, as opposed to visiting the Eifel Tower which represents a fixed activity location with specific opening times and location. These are representing *space-time stations*, representing tourist destinations, historic castle or a host's residence. Potential path area and prisms are created using a traveler's desired travel destinations in a specified duration of time along with available modes of transportation. The traveler has a space time prism (TSP) with height boundaries determined by the traveler's available time. The lowest height represents the beginning of the trip and the maximum height the ending time of the trip. With respect to the lodging system in this research, different optional sequences result based on host availability. In addition to TSP he acknowledges the existence of network time prisms (NTP), which in his case represent the analogous form of the physical TSP in the virtual reality. NTP have constraints they share with TSP, but also constraints that are unique to the virtual environment. A major difference between the two is that NTP has irregular shapes, depending more on the network structure. Technical devices represent physical portals connecting the virtual to the physical. Unfortunately he does not explore NTP further, he simply states they exist and moves on.

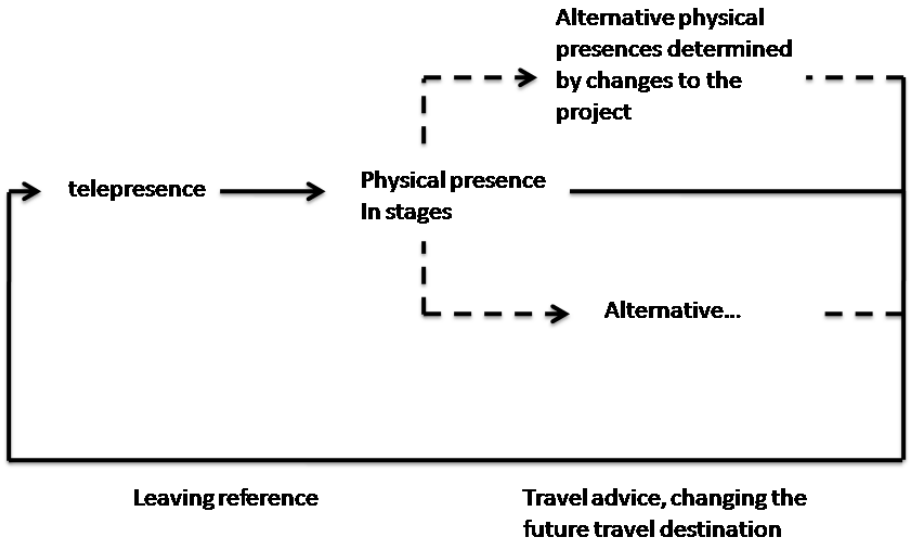

Figure 6: author's schematic of the different presences in a CS experience, source: author

The above scheme (look Figure 6) represents how an individual changes its modes of presence within the conducting of a CS based trip. The guest contacts the host asking for accommodation, if accepted the stay occurs. The two CS members may eat meals and sleep in the same house. The next day the host may take the guest out on a tour around town. At the end of the trip the host may suggest possible future travel location, possibly altering the traveler's path if the traveler decides to follow the advice. After the conclusion of the stay the two individuals go their separate ways. Further contact remains virtually, by leaving a reference or staying in touch via email or other virtual media.

The initial starting position starts by contact via telepresence, usually internet based, but phone or letters are also possible. This leads to a more and more exchange of information between individuals, providing address and time for the meeting, etc. This eventually leads to a physical meeting of the traveler with the host. Once the traveler arrives, the projects of the travelers usually changes

according to the information obtained by the host creating alternative physical presences that either realizes or not. Like the host suggesting to visit a certain site or similar. At the end of the stay the host usually gives recommendation for other possible sites to visit, possibly further changing the project of the traveler. Also the presence returns from being physical to being virtual, by the both the host and the guest leaving a reference on the CS profile for each other, than the cycle starts anew with a different person. Pultar maps both virtual and physical presence as time space paths, unifying the virtual and physical life path within the same time space prism.

After modeling the physical and virtual movement of members in the CS network Pultar continues exploration of how an individual navigates the CS network. His discussion focuses on how CS members utilize the reference system and how people are viewed inside the network. He elaborates this by invoking social capital, recognizing that members with many positive references have more social capital than members with fewer references. Next follows the Actor-Network presentation of Case A.

5.1.4 Case A: Actor-Network Theory

The main methodological advice of ANT is that one should *follow the actors* (Latour 1996), so let's start by outlining the main actors in the practical examples giving by Pultar. The main actors are:

- The traveler, guest in a CS sense
- The host, allowing for accommodation
- The residence of the host
- The CS network
- The internet, utilized to access CS, buy plane tickets, keep in contact via email etc.
- Mobile devices allowing access to the internet and each other, like computers, phones etc.
- Plane, trains busses etc. means of transportation

Obviously there are more actors involved, but for the analysis at hand let's focus on these and outline the network from their position. All these actors exist in networks allowing them to function the way they are. An example represents the maintenance of the CS internet page, this is not influencing the actors in the described case directly but it is a necessary component for other actors (guest and host), enabling communication. The same applies to the economic situation of the host, the logistics of plane travel, the political stability of the visited country etc. All these spheres present different networks on different topological levels requiring an actor (guest in the example) to transverse these to realize the planned trip to Europe.

5.1.5 Female American Traveler II

The network from the guest perspective of female traveler initially represents a weak position, having no alliance to other actors in the networks around her. First as she buys her plane tickets and contacts the host she is creating these alliances necessary for the realization of the trip. All enabled by the utilization of another actor the internet, CS, online plane ticket sites etc. In a sense she is building a network for the realization of this particular trip which she coordinates. All these efforts increase her relative strength and enable her to conduct the trip.

During the trip she creates more alliances with the actors she is engaging, further increasing her relative strength position. List of a selection of alliances represent:

- The friends of a local host providing her with accommodation at a cultural festival
- The cheap plane ticket left by a previous host enabled her to fly to the Czech Republic
- The packed lunches provided by the hosts in Vienna
- The information provided by the hosts about museums and public transportation
- etc.

This represents a short selection of all the alliances she built during the trip that allowed her to better coordinate the network and increased her relative strength position further. These alliances increased the overall cultural experience of the trip. The creation of all these alliances made her travel the memorable experience that it now represents for her. She created a strong network that left a strong impression on her due to the utilization of these alliances.

This is just the network from the perspective of the guest. The same is true from the perspective of the host, taking the guest into his home, creating an alliance with her and hopefully a pleasurable experience for the host. A positive experience of the guest results in a positive reference on the CS site for the host, increasing the host strength position inside the CS network. Also for the airplane company receiving money for providing means of transportation etc. creating intricate networks that are linked at different topological levels. It is the coordination of different networks that allows people to realize different projects and endeavors.

5.1.6 South American Professor II

The travel of the professor is similar to female traveler in regard to enlisting different alliances from different actors. The difference lies in the engagement of other networks of the traveler (participating in the conference), which the female traveler is not encountering. This allows for a lesser degree of freedom of action for the professor.

5.1.7 Coordination inside the CS Network

Instead of invoking social capital to analyze the functioning of the CS network like Pultar. This function represents a textbook case of alliance building of ANT. The reference system in CS allows users to coordinate their travel, becoming an important actor in itself, helping with coordination inside the network. Further Pultar recognizes that individuals with many positive references adopt a very strong position inside the network. Therefore this represents alliance building quite literal in that lots of alliance result in stronger position in regard to CS network and vice versa (look figure 7).

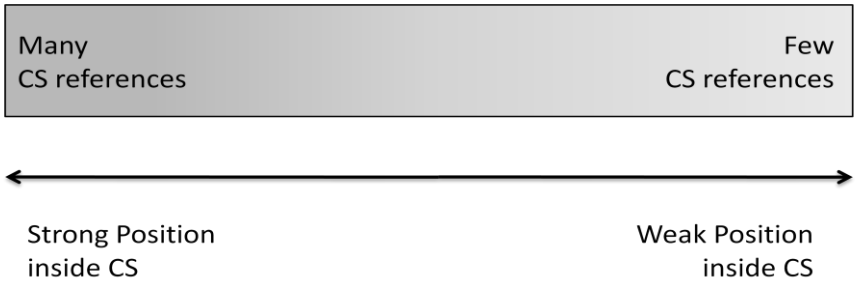

Figure 7: strength relation within the CS network, source: author

Therefore ANT presents social capital as part of alliance building. Furthermore the description of the two different traveler examples does not differ significantly, because both utilized similar networks for their travel.

5.1.8 Telepresence in Case A

This particular study analyzing CS serves as an example how the utilization of new technologies constantly creates new possibilities. In a sense the LSBN of CS affords new kind of tourism formerly impossible because people lacked the possibility to network with each other in qualitative new ways due to the advent of ICT.

CS affords a new type of tourism, by people going off *the beaten path.* The new aspect of CS represents the possibility to contact large groups of people and to interact with them in a manageable format. It's difficult to conceive an alternative type organization not aided by ICT and telepresence organizing 2.5 million members in over 200 different countries around the world.

Telepresence is vital for the creation and maintenance of these networks. This particular network represented a decentralized network structure where the admins of the CS website only maintain the platform while the interaction is handled by the users themselves. This type of structure is so geographically dispersed; in order to have any meaningful and large scale impact necessitates synchronous and asynchronous telepresence. This allows for the claim that telepresence enabled by ICT affords new types of social interaction.

5.2 Case B: Yin

Human Interactions in Physical and Virtual Spaces: A GIS-based Time-Geographic Exploratory Approach
by Ling Yin
from: The University of Tennessee, Knoxville, USA
published: 2011

The second study is an inquiry by Ling Yin to understand how telephone communication affects people's face-to-face (F2F) meeting opportunities and how individuals utilize social networks. Her main study objectives represent the operationalization of Time Geography in a context of virtual reality, utilizing GIS. Her specific objectives represent:

- How can Time Geography be extended to assess potential F2F meeting between people using the telephone?
- How can Time Geography be used to describe and explore virtual space and virtual interaction? Inside a GIS approach
- How can virtual time prisms be defined?
- What is the relation between physical proximity and virtual proximity in social networks?

She wants to create a toolbox from Time Geography able to handle both physical and virtual reality simultaneously, accommodating constraints from both the physical and virtual spheres. She creates different phone call scenarios based on different levels of constraints, to assess the potential F2F meeting opportunities of individuals. Claiming that this recursive interaction between physical and virtual is best understood out of an individual focused approach, not a location based approach traditionally common in Time Geography. For analyzing a social network she turns to a group of

university students' use of different social networks. She analysis this group both, from a physical location perspective of the user and from a network location perspective of the user.

She recognizes that information flows between two places in the virtual world represents access through the uses of physical portals (telephone computer, etc.). These represent portals that link the virtual world to the physical world and vice versa. This ICT implementation blurred traditional boundaries, like that of office, home and the functions of place. Therefore a focus on individuals is to prefer over focus on place, because contemporary places have multiple functions. She claims that the dynamic relationships from virtual interaction back to physical effect are not clearly handled by current Time Geography, with a focus on place. A Time Geography based on individual trajectories in virtual space and physical is needed to account for this.

She acknowledges that other constraint based models like: *discrete choice model, rule-based model and simulation model* all have to adjust like Time Geography for this ambiguous character of interaction between virtual and physical space, leading them to integrating one and the other, becoming more and more similar. To accommodate for difficulty she extends Time Geography to include an *activity based approach* and *social network analysis*. The social network analysis is combined with Time Geography to account for the virtual sphere and creating better explanation, according to her. Seeing the virtual as topological different sphere where topological distance is determined by patterns inside the network, rather than by Euclidian distance. Recognizing that social networks have an n–dimensional topology creates a virtual geography. This extension to the virtual creates new concepts like virtual space time path and a virtual space time prism.

5.2.1 Case B: Time Geography and Telephones

Capability constraints along with *coupling constraints* represented the basis to formulate different phone case scenarios. *Fixed and flexible actives* in the phone case created a personal *space time paths*, of several individuals to see where they have F2F time spot meeting opportunities. Departing from classical *potential activity area*, rather than predicting an individual's persons behavior probabilities are assigned to different actions creating a *probabilistic space time prism*. However the division into fixed and flexible activities is ambiguous in today's world dominated by ICT. She explicitly acknowledges the *fragmentation of activity hypothesis* and accommodates accordingly. The uncertainty leads to the creation of rough space time prism and dynamic prism, relaxing the constraints because of the impact of ICT. This allows for recursive interaction between physical and virtual reality. In addition peoples planed and fixed activities change over course of the day. With land line phones individuals need convergence both in physical location and in time, even if its not the same physical location. However with mobile phone they only need temporal convergence, since the phone is always assumed to be with the person.

In these changing conditions of different individual time space paths, telephones represented a possibility to coordinate meeting opportunities. Meetings realized themselves in that individual A called individual B, prospecting for a possible meeting time, confirming the meeting time and making possible adjustment in case of conflict later on. This greatly increased their meeting opportunities as compared to cases without the availability of a phone call, for both landlines and mobile phones. Mobile phones represented the greatest increase in potential meeting opportunities.

She modeled these potential meeting opportunities both theoretical and experimental employing a GIS based model. She recognized that the actual time space prism looked different from the theoretical shape due to the implementation of ICT and other technologies. Also that just ICT access is not enough to ensure a F2F meeting when other restrictions are overwhelming the possibility. She gives the example of a person not being able to physically take themselves to a meeting because of a not owning a car. According to her this creates a potential explanation why sometimes telecommunication is preferred over F2F meetings, when one is not physically able to take themselves to the meeting point. But in most cases the utilization of ICT positively changed the probability for potential F2F meeting opportunities.

5.2.2 Case B: Time Geography and Social Networks

For the social network analysis a group of former students of the Nanjing University's geography department represented the sample group. All students represented former classmates of the author entering the department between 1998 and 2004 and graduating between 2003 and 2008. This group of 44 potential individuals utilized social networks like the bulletin board system of Nanjing University but later transitioned to utilizing facebook and Kaixin (a Chinese equivalent to facebook, being initiated in 2008). The basis of the analysis represented data logs of the communication between individuals, their online communication history, and history of residence and ICT habits in maintaining the social network.

First she modeled the connections of the individuals from their physical location of the users, according to the traditional location focus in Time Geography. The physical location of the server or user´s computer posed as a proxy for the individual's location. However in virtual space the lag of distance is negligible to some extent, therefore this presents mainly a point of departure for the presentation. She gives the examples of members of the same social network living in China, but also in Europe and the USA. All being physical separated by distance, but still being members of the same social network. She acknowledges that the presentation departing from the physical location of the user is possible but no knowledge gains occur from this particular style of presentation in regard to the structure of the social network.

Illumination of network structure is difficult departing from the physical location. In addition a presentation of the network structure is impossible from a singular observation. Only longitudinal observations reveal the network structure, illuminating the network shape and function. The structure reveals itself according to the contact between the different members of the network, many connections representing a relative closeness inside social network system space (SNS), while few connections correspond to distant relation. Observing over longer periods of time enables the creation of social space time paths in SNS space. With this approach she continues to models the social networks according to their network locations, based on individual focus inside the SNS space.

Geographical places are material, forming a defined set of constraints and coordinates; these correspond to the classical concepts of Time Geography. Meanwhile virtual space (internet, telephones web pages and such) form a coordinate system that is not similar to Euclidean coordinates, rather it is subject to the network structure. Alongside these multi topological levels the virtual is subject to specific constraints that are emergent from the network structure. The constraints virtual reality faces are partially analogous to physical constraints, like the physical limitations of the users seen as access constraints. For example a user cannot access a network when

he or she is sleeping. Purely virtual constraints are depended on the structure of the network, for example commenting on people's status updates inside facebook is only possible for friends of that particular user. Therefore her virtual space time paths in SNS space are based on social network analysis, virtual time paths are depictured with topological distance.

Virtual distance creates itself by counting the connections between different individuals, trying for a best fit mapping approach. She applied cluster analysis to identify different groups within the SNS space. She manages to distinguish different groups, suggesting that these groups are correlated to social connections based on similar course attendance and real social ties. However these aggregate patterns of the group did not reflect individual movement, not revealing the unique patterns of a single individual inside the SNS space.

As she compared the two modeling approaches she concludes that in general the network approach is preferable to the geographical approach. Because it gave clues about the social structure of the social networks, and that the individual character seemed far more important in maintaining ties between the individuals than their geographical location. Nevertheless geographical location still impacted social networks, revealing the time delay impact on social networks. Individuals in China commented without time delay on friends in China status updates. During this time friends in the USA slept due to the different time zones, therefore their status updates first occurred on their morning representing a several hour time delay. Therefore a combination of both approaches is optimal, seeing both approaches as complementary.

During the whole creation of both approaches she gives several possible explanation of why the particular received patterns take the shape they take. Like individuals moving to different cities, being friends in real life etc. However all these are speculations by her, not being presented as matter of fact cases.

5.2.3 Case B: Actor-Network Theory

She talks about social network analysis recognizing topological distance according to the makeup of the networks. This is analogous to Laws (2002) claim that different networks have different topological levels. Distance is not metrical but determined by semiotic patterns inside the network (Law 2002: 90). Seeing virtual space as a global network of information and communications technology infrastructure; including telephones and computer networks, representing one form of topological network space in which movement is possible.

5.2.4 Telephones

In the phone case it is apparent that the interaction of two human actors is greatly facilitated by the employment of another technological actor, i.e. the phone. This enables easier coordination between the individuals leading to more possible F2F meeting, than compared without the utilization of the phone. In this sense telephones afforded more possible F2F meeting for the person involved. Viewing it in the way of affordance, the different between landline and mobile phones represents that the mobile phone has the property of mobility. This afforded mobile communication further increasing the possibility for potential F2F meetings.

In one example giving by her an individual is late for the meeting because of a car congestion (she drives) therefore she informs her colleagues of her whereabouts utilizing her mobile phone. The combination of different actors like: the caller, the phone, the car, other cars, the meeting people

forms differences alliances and affording different properties. Like the possibility that she can inform others about her whereabouts. However as recognized by ANT nothing is free, everything costs. The network of cars needs maintenance represented by; fuel, maintenance of the car, but also road maintenance and expansion of road etc. For example improper expansion of road capacity leads to congestions experienced by the driver in the example. The same applies for the phone network that is necessitating certain standards for continued function. Like charge on the battery for mobile phones etc. but also knowing the number of the person one wishes to call. Only with this knowledge a successful phone call becomes possible. Thereby the phone number creates a form of immutable mobile that is necessary for a person to utilize the phone network and benefit from it. All these components require properly function otherwise the network fails. This is exemplified by Yin in another example where a person could not physically take herself to the meeting because of not having access to a car.

5.2.5 Social Networks

As explained above closeness and virtual space defines itself through semiotic pattern, and is not metric in the same sense that physical space is. Semiotic patterns being the messages individual send each other, which site they visit, which updates they like and mm. In essence each time an action is made. Thereby these virtual activities shape the virtual space time path. The physical location used as a point of departure entails no information about network structure. From a singular observation it is impossible to determine the structure of a network, but observed over a period of time the network structure emerges by revealing how the network is functioning. Essentially her approach of individual based focus departing from social network analysis is in general very similar to an ANT account of the situation.

Regarding interpretation of the patterns received by Yin's extended Time Geography, they remained mostly speculative. However an actor-network perspective interprets them as the individuals maintaining network alliances. Friendships like everything else needs maintenance, frequent contact being expressions of strong friendship ties, while less frequent contact is an expression of weak social alliances.

Also understanding the social network structure out of an affordance viewpoint illuminates different properties not fully explained by Time Geography´s approach. Like in 2008 most of the people graduated and afterwards became unable to access the university intranet, therefore they transferred to other social network site (like facebook and Kaixin), for some individuals this transition corresponded to a drastic increase in virtual communication. She speculates that this is resulted because the individual moved to different city and no longer maintained daily contact as before. If analyzed from an ANT perspective this claim strengthens for the person in question. Stating that the person in question placed in new scenario actively creates new alliance; some of these represent strengthening older alliances. This claim is not speculative as in the interpretation giving by Yin.

In addition the new SNS platforms possibly afforded different kind of communication as the university bulletin board, having a different structure. The same applies for her finding that the individual character of the actor was more important in explaining the network utilization than their physical location. Individuals who had close contact, maintained that close contact regardless of physical location, again in terms of alliances and network maintenance this situation represents a textbook case of network building enterprise. The whole SNS enterprise is essentially network

building and network maintaining. By strengthening older alliances regardless of physical distance and creating new alliances with particular social networks.

5.2.6 Telepresence in Case B

Phone telepresence clearly enabled more meeting opportunities than without the utilization; thereby telepresence became a means of coordination between actors.

With the social network case, the semiotic patterns increased when the individuals finished university and moved apart. Yin´s speculation claimed that the interaction moved from the physical sphere to the virtual sphere. Regardless of the truth of this claim telepresence afforded by social networks represents a means of maintaining existing social networks despite geographical separation.

These networks afforded the members of this particular social group to *stay in touch* despite living on different continents. This communication is possible without invoking ICT, however with the aid of ICT the time delay in this communication is cut from weeks to sometimes only seconds. Telepresence allows friendships to remain in different geographical settings despite the *tyranny of distance* compared to their absence. In a way telepresence affords the maintenance of friendships despite geographical separation. However because of the network structure only certain type of interaction are afforded, only messaging friends etc. thereby telepresence introduces different form of constraint that requiring adherence in order to benefit from its positive effect of the social network. If a person intents to benefit from network, that person needs to adhere to the rules posed by this network. Exemplified in the phone case scenario were knowledge of the phone number of the person called represents a necessity for establishing contact.

5.3 Case C: Baker

Dynamic Trip Modeling - From Shopping Centers to the Internet
by Robert G.V. Baker
from: The School of Human and Environmental Studies, University of New England, Australia
published: 2006

The aim of the study by Robert G.V. Baker represented the creation of a consumer based model explaining the movement of consumers gravitating towards different agglomerations of shopping facilities. Baker expresses the belief that the created model applies to modeling both physical and virtual reality alike. Hence he applies his model to physical shopping trips of consumers and global internet usage. He basis his analysis model on the retail aggregate space-time trip model (RASTT), developed by him in previous studies. Baker extends this model and further modifies it theoretically as it tested against real world scenarios. The real world scenarios result from surveys conducted in different shopping centers in Australia and New Zealand. The empirical data of these surveys is contrasted to the theoretical predictions of the RASTT model. Baker concludes the feasibility of the model, corroborating the initial assumptions. The internet analysis departs from a data series of the Stanford University Internet Project. This data represented the empirical foundation of virtual movement and information flow in the internet.

The RASTT model that is at the core of the analysis is constructed from a synergy of several quantitative approaches not just Time Geography. The concepts that are used to construct the RASTT model are mainly taken from the quantitative Time Geography, building on Hägerstrand's and Lentorp's early work from the 1970s. This is combined with *inventory analysis, central place analysis, stochastic process* and *spatial interaction*, each of which contributing to the creation of the model. This combination is an attempt to overcome the shortcomings of quantitative modeling, because critics of quantitative modeling claim they are derived more from physical analogy or economic assumption than empirical data. Nevertheless Baker basis his model mainly on mathematical models, but tries to overcome this inadequacy by comparing his result to empirical surveys. By doing this he acknowledges the importance of a synergy of both quantitative analysis and qualitative research. Still the majority of his work is strongly gravitating toward the quantitative aspect, even in the conducted survey interviews.

Time Geography contributes with understanding of time and place. In traditional calculus models of spatial modeling time is treated as infinite. However in a geographical context as recognized by Time Geography, there exist finite time spans for projects. These represent everything from minutes, hours, day's weeks or months to years, decades, centuries or longer all depending on what time span a particular project necessitates. This becomes integral to modeling retail hours of businesses. Baker adopts the time span of a 24 h timeframe; thereby it is possible to categorize consumers by their time availability, having *time-poor* consumers for example. The place concept is represented by place being actual physical entity that is affecting the choices of the individuals, taking a step away from *best case* model scenarios. Best case scenarios are inherently flawed as recognized by Pred (1967). He suggested that shoppers probably have incomplete knowledge about retail distribution and the best possible scenario of trip allocation. Therefore they operating out of a satisfactory approach, instead best possible case scenario. These assumptions adhere to the suggestion by Hägerstrand (1970) *What about people in regional science?* incorporating and individual focus and the human element into statistical modeling. The results take the form of probabilistic presentation presenting, possible case scenarios with allocated probability values for particular trip choices of consumers. Creating educated guesses why the outcomes of the particular shapes are received.

5.3.1 The Internet Modeling

He applies the same model to the internet. Utilizing a data series created from the Stanford University Internet Project. The project featured 27 global monitoring sites in 2000, pinging transaction every hour to 171 remote hosts distributed around the world. Recording the time delay it took for the ping package to arrive. The coordination of dataflow in the internet is established by buffer stations that redistribute information along possible pathways to the target destinations. Each pathway has a finite capacity of the amount of information it transfers. If this capacity is reached a different route for the information flow is allocated. This new route most likely takes longer than the original route. Thereby the measurement of time delay for the pings becomes a proxy measurement for overall internet traffic. In this view the internet becomes a network of nodes and links forming a complex structure known as cyberspace.

He recognizes that different franchises have different businesses models, like discounters aiming for high turnover rates, pressing price margins. Similar businesses model apply for internets business as well, having less restriction of opening hours and worker management, compared to physical businesses. Creating a qualitative different position in the virtual realm, this difference either represents a possibility for exploitation or a hurdle in need of compensation.

The recognition that time is not infinite but subject to a 24 h daily cycle also applies to the internet. The mathematical equations of the RASTT model give two sets of answers, a positive and a negative. Usually the concept of negative time is regarded as nonsensical in the face of physical modeling. However Backer claims in a virtual scenario this answer may entail meaning. Virtual modeling faces different time zones along the earth's surface that in turn represent either positive or negative time in regard to the current location. In this view the rotation of the earth became the zero value for each and every individual point. Thereby positive and negative time represented simultaneous presence at multiple places of the earth's surface, i.e. telepresence.

Baker's result showed a clear time dependency, observed as taking the shape of a wave form of activity spreading round the globe at peak hours of internet use. There were two recognizable waves, one from the rotation of the earth and one from local origin destination pairs. Therefore he concludes there is no *death of distance* because location is still important, even in the internet. Also in his opinion this analysis corroborates the operator based approach for this type of modeling, using their geographical location as proxies. One of the main conclusions of this study is the difference between *real* and *virtual space* is possible to express by invoking positive and negative time. This is accounting for the impossibility of multiple physical presences, while this is fully possible virtually. The possibility to model both physical and virtual cases corroborates his belief that both spheres are potentially unifiable within one explanatory framework.

5.3.2 Case C: Actor-Network Theory

ANT describes the internet case as creating alliances with technological artifacts, increasing the strength of the resulting composite actors. Alone humans are not capable to take in information from several places around the world simultaneously. Because of the *tyranny of distance* a person is only able to act in one's physical proximity. However with the help of technology a user extends his or her reach far beyond the physical proximity. Thereby the user utilizes opportunities not possible before the extension. However it comes at a price, in that the resulting network requires maintenance (cables, satellites, etc.) and that the users is familiar with the utilization of the network, adhering to the procedures inside the network, web addresses, HTLM code etc (representing immutable mobiles).

The same applies for retail situations; Baker describes the retailer as being a middleman between producer and consumer. Creating a network that enables consumers to choose from a variety of different producers, not only the ones that are close to their physical proximity. This retail network increase the strength of all involved parties, producers cater to a great diversity of consumers, retailers gain capital by providing the function and consumers getting a greater diversity of consumables. However each of this benefit comes with cost, the producer is required to adhere to the price given by the retailer, the retailer has to maintain the structure and keep goods available, while the consumer pays an extra price for the service of the retailer. These network structures are

essentially the same, regardless if they are created with physical networks only or extended to virtual shopping sites.

He describes shrinkage of space of the earth surface due to technological advances. He refers to the traditional geographical presentation as shrinkage of space. Cars and airplanes are space transcending technologies and the internet with its almost instantaneous communication being the ultimate form of space transcending technology. ANT would not present this case as decay of distance rather that actors are increasing their relative strength, constructing new alliances with other (technological) actors. The alliance with cars enables us to move greater distances, as we are able by foot. The alliance with planes allows for even greater mobility still and the internet being the ultimate alliance allowing for theoretical almost simultaneous presence everywhere around the globe. However all these alliance are costly and have to be maintained the greater the benefit the greater the cost.

5.3.3 Telepresence in Case C

The previous Case B telepresence mentioned the restriction that an individual is required to abide in order to utilize a network. Case C presents a further restriction introduced by technology, that there occurs temporal delay on peak hours of usage. This represents not so much a restriction but a consecutive problem created due to increasing complexity, in this case increased use.

The problem may only represent a few seconds delay for the individual user nevertheless its represents a property of the network when many people use it simultaneously. In chapter 2 Urry (2003) mentioned that networks gain in value the more they are connected. Case C here presents the same reasoning, but acknowledged from ANT's concept that connection is costly, the more users are connected the more variables are involved and the difficulty increases in maintaining the network. Large networks are inherently more complex to manage, as compared to smaller networks due to the increase in variables.

The time delay problem touched upon in telepresence here is arguably insignificant at current levels of usage. However our lives are increasingly getting more and more networked (Urry 2003). So it's not just that the number of sheer internet users is increasing, it's also that the tasks that the internet is utilized for is increasing for the current users. All this creates further stress on the network. What kind of problem this increased stress produces is difficult to predict, it's not difficult to predict however that problems will occur if utilization increases.

6. Analysis

Each study described above clearly differed in respect on the study subject, leading to obvious differences in method design, area of inquiry and background. Regardless of these differences there were similarities among the three different cases. This chapter starts an elaboration on the overarching similarities of the studies presented in the previous chapter. The next step represents contrasting the different approaches used by the case studies overcoming similar problems, as being a theoretical discussion where they differed. Continuing with how each study describes telepresence and what possible benefits Time Geography and Actor-Network Theory possibly draw from this study. The chapter concludes with my attempt to synthesize particular concepts of both approaches into one in regards to telepresence.

6.1 Similarities of the Case Studies

The quantitative approach to studying Information and Communications (ICT) impact on society represented a major point of convergence for all three studies. Two of the three studies directly applied and modified Time Geography in a GIS environment, while Baker's study used the tenants of Time Geography as a basis for a mathematical modeling. Baker's compared his RASTT model to quantitatively obtained survey interviews and adjusted accordingly. The other two operationalised Time Geography in an ICT context by utilizing the constraints of Time Geography and extending them if needed in a virtual context. In addition Yin even re-revalued the assumption of fixed and flexible activities modifying the concept according to her understanding into a more fluid concept, instead of bivariate concept. This resulted into a probabilistic result, allocating different probabilities to different outcomes of the life paths. As Yin acknowledges the *"space-time prism approach identifies an individual's potential activity opportunities rather than predicting an individual's behavior"* (Yin 2011: 11).

The probabilistic and potential path area answer created difficulties for the authors when faced with interpretation of particular outcomes resulting in more speculation than analysis. Pultar refrained from speculation all together, invoking a whole new concept of social capital into Time Geography to explain coordination inside the CouchSurfing network (CS). As Yin discussed the particular effects of telephone communication, social network utilization on individuals she only asserts that *"These factors might influence friendship, and social networking websites may catch such impact"* (Yin 2011: 196). She refrains from further specifying how this relationship functions, moving on to discuss temporal convergence inside social networks. In Baker's study the same notion surfaced, claiming his model *"provides a possible explanation for the decline in the number of major supermarket chains trading 24 hours per day"* (Baker 2006: 225). He states this in regard to the decline of 24 hours per day supermarkets in Australia, his models shows that opening hours in the early morning are inefficient for supermarkets. He only states that this is a possible explanation and not the *real* explanation. Cynically I am possibly over overemphasizing academic hedging, especially on Baker's behalf. However these kinds of difficulties were reoccurring themes throughout all three studies, they surfaced on several occasions as soon as particular interpretation occurred. Thereby I take it as corroborating Schwanen's (2007) proposition that Time Geography and quantitative approaches in general face difficulties interpreting particular outcomes of time space paths and actions. Even Baker acknowledges this when he admits the shortcomings of quantitative modeling, claiming that the solution lies in complementary approach with qualitative research and

understanding the shortcomings of these kinds of generalizations (Baker 2006: 31). Yin and Pultar turned to social network analysis and social capital respectively for gaining clear insight into how coordination functions within networks, presupposing a need for supplementation created by Time Geography not covering these areas sufficiently.

A further point of convergence in all three studies represents the credence given by the researchers to the interconnectedness of physical and virtual realm. Physical artifacts like telephones or computers with internet access are portrayed as representing portals between the two spheres. All three studies understood the relation between physical and virtual as being recursive, the physical effects the virtual and vice versa creating a chain of cause and effect in both directions. All three authors assumed that older explanation models faced difficulties explaining these new hybrid realities. This is exemplified by each of them turning to other approaches in order to understand these new complex realities. Nevertheless all three shared the belief that the physical and the virtual are potentially unifiable in one particular framework that comprehends both spheres simultaneously.

All three also acknowledged that distance lost its importance in regard to communication and information flow, however distance retained it's important in physical movement and needs of individuals. Therefore all three expressed the belief that the importance of distance stands corroborated.

6.2 Differences of the Case Studies

The perceived need to extend Time Geography, to incorporate and account for the consequences of ICT implementation took different forms in the three studies. Obviously these were affected by the area of inquiry. Backer turned to several different approaches besides Time Geography to create his mathematical RASTT model, explaining both physical travel and internet activity. The approaches he utilized represented:

Inventory Analysis: describing travel demand as a function based on goods distribution and demand plus the frequency of travel. Space-time is seen as a composite of storage cost, leisure time and commodity type that together form a time maximizing framework. The temporal aspect in combination with a spatial defined area allows for accounting of multi-purpose and multi-stop shopping behavior. It is this aspect that Baker is mainly utilizing of the framework.

Central Place Analysis: obviously bases itself on Christaller's Central Place Theory as the name suggests. The theory received modification to account for shopping trip behavior. Seeing shopping as satisfactory enterprise mainly defined by the qualities of commodities. Operationalised with the help of the gravity model it severs as an explanation to why shopping trips occur to particular locations.

Stochastic Process: based on the Markov chain, where the probability of the next variable only depends on the current value and not upon any previous value. The chain is an analogy to the assumption that shopping behavior is memoryless, only depending on the last shopping experience. This creates a transition matrix that is independent of sub populations and environment since it only depends on the previous status, utilized by him to account for reoccurring shopping behavior.

Spatial Interaction: being an approach to aggregate trip cycles using the Fourier analysis that allows for comparison between empirical and theoretical frequency distribution. Incorporating a function for deconstructing time and space into interdependent variables with shifting relative positions, this allows for the creation of time-decounting or space-decounting behavior in shopping experience. The solution is a negatively exponential gravity model.

All these different approaches together create Baker's RASTT model accounting for physical shopping behavior and internet activity. Both these activities are modeled as granular flows between different localities.

Pultar as explained above extended his analysis to *social capital* to understand coordination within the CS network. Yin extended her analytical model by incorporating an *activity based approach* and *social network analysis*. The choice of Yin's activity based approach resulted directly from Coucelious (2009) proposition that this solves the difficulties created by the fragmentation of activity and represents a possible solution to understand social networks. Because activity no longer intrinsically correlates to only one location rather occupies multiple physical locations. Therefore Coucelious favored an individual based approach over a location based approach. Yin applies this individual focus when modeling social networks inside virtual space out of a social network analysis perspective. The Individual serves as the point of departure and mapping their relative closeness depends on their topological distances to other members of the network.

With this multitude of different approaches the style of result presentation varied greatly among the different studies. Baker presented his results as wave patterns in three-dimensional graphs alongside probability graphs and solutions to the calculus equations. Pultar presented virtual and physical contact within the same time space prism allocating different colors to physical and virtual contact. He only mapped the time space paths of single individuals but claimed the style of presentation also allows for mapping of multiple life paths and prisms. Yin presented her results for the telephone case as both theoretical and actual time prisms, highlighting the potential F2F meeting areas. While in her social network case she mapped the virtual space time paths both from a location based approach and an individual based approach. Yin represented the only one to conduct an individual based approach among the three studies. Nevertheless her combination of the two approaches clearly generated useful results to understand social networks.

6.3 Different Modes of Explanations for Telepresence

The notion of telepresence is central in all three studies. However the way this phenomenon is conceptualized differs greatly between the studies. Baker accounts for simultaneous presence on several locations of the globe with negative and positive time in regard to a fixed location. Thereby he is creating convergence in virtual space at different relative times. Pultar conceptualizes telepresence in being a constant back and forth movement between physical and virtual spheres while Yin calls this movement recursive. In Pultar's case the recursive movement leads to a gradual shift from virtual presence to physical presence and then back again. Interaction between two parties solidifies co-presence that eventually turns from virtual to physical and back. Yin's dual approach of presentation manages telepresence in two separate ways. One location based approach strongly resembling Pultar's approach and the individual centered approach that is created within her social network system space (SNS). In this SNS space distance is expressed as topological distance depending on network patterns and interaction. Because the interaction between different parties in

the network is correlated into a topological distance, cluster analysis gives direct clues about network structure. She claims that the individual based approach better illuminates network structure. However she notes that both approaches are complementary, in that the location based approach accounts for the uniqueness of place adding specific understanding about the geographical location to the general understanding of network structure.

The different models of explanation interpreted by an Actor-Network approach had a general similar structure. That human actors enlisted the help of technological actors (internet, phones etc.) these technological alliances enabled the human actors in term to create further alliance with other human actors. This whole enterprise of alliance building and maintaining culminated into a network building process. The created network represented a need for coordination and maintenance, by different actors. Technological actors like the CS reference system helped human actors with network coordination. Social network sites like facebook helped among others with network maintenance, allowing human actors to keep contact with distant alliances despite physical separation. All these different technological actors, like the CS reference system or facebook constitute networks in themselves. Thereby as Law (2002) recognizes different topological levels are created require maintenance to ensure their function.

This results in seeing all these networks as different topological levels, contrary to geographical picture that the world is getting smaller, the world or collection of networks is getting bigger, or more adequately phrased: complex. Latour (1999a) claims that each benefit is costly and added benefit adds cost to a network. Each step of the way more and more effort is needed to ensure the function of a system, or network. Only by ignoring the agency of object and black boxing their function can we even begin to speak of a world that is getting smaller, instead of bigger and more and more complex by each additional technology (Latour 1999a: 168). Telepresence in this view becomes a property of technology. The telepresence created by ICT similar to other information transferring technologies affords new kinds of interaction. In Case A this is exemplified by creating a new type of tourism, allowing travelers to experience the point of view of the locals. These possibilities existed previous, but not in the same magnitude, this magnate is afforded by telepresence of ICT. In addition to affording entirely new structures like LSBN, telepresence also helps with the maintenance of existing social structures. Case B, showed that social network sites enable the maintenance of friendships despite geographical separation. However these forms of telepresences necessitated a specific type of access and only allowed for specific type of communication. All depending on the possibilities and conditions of the technologies involved. The last case C showed that these specific requirements of telepresence can in turn create their own difficulties and problems. Because nothing is free and all networks are historically contingent (Mol 2010: 263)

6.4 Time Geography versus Actor-Network Theory

The journey was long to reach this point let's recapitulate the lessoned learned once again first for the two approaches separately, before moving to core intention of this study a possible combination of certain concepts. But regardless if the two approaches are combinable both approaches clearly benefit from each other, at least in drawing inspiration how to deal with certain difficulties.

Yin's study showed that both Time Geography and ANT can possibly unite inside one framework. She did not do this directly, however she employed many similar concepts like; *topological distance* and the *multi-dimensional character* of the virtual sphere. These concepts have direct analogues inside ANT, even if ANT is taking these concepts further explaining every mode of organization in the terms of topologies and networks and not just virtual networks.

This is a clear sign that these two bodies of work are compatible, just like Schwanen suggested (2007). Schwanen's suggestion that Time Geography possibly benefit from ANT's ability to describe coordination and alliance building within networks, for interpretations of particular outcome of time space paths seems reasonable according to the three studies analyzed. All three expressed difficulties accounting for particular outcomes, either turning to other frameworks like social capital or just speculating. The main solution applied represented assigning probabilities to different choices of action, however this still didn't changed the fact that particular outcomes remained hard to account for.

In addition ANT contributes to Time Geography understanding of network functioning, as exemplified in Yin's case when she described the network structure of the social network sites. This kind of description can theoretically apply to every network, when using ANT regardless if it is virtual or physical. In Yin's case this insight illuminated the network structure and how the members of the network interacted. This sort of understanding seems beneficial to every type of geographical inquiry.

Even ANT possibly benefit from a discussion of both approaches. As seen in the previous chapter the description of ANT for the different cases were all kept very general. This is a direct result out of the diffuse character of ANT as a theory and possibly the lack of sufficient details. Nevertheless as Oudshoorn (2012) points out it also represents an under appreciation of the uniqueness of place, which is a large part of any geographical enquiry. Yin's dual approach clearly retained geographical uniqueness while simultaneously accounting for network structure, thereby representing a possible source of inspiration for ANT to address this particular difficulty.

The generality of description of ANT faced another difficulty. If everything is described in terms of network building, failure or success become a direct result out of the network building process. This denies the importance of outside influences facilitating or inhibiting the construction of the network that are not direct part of the network. Time Geography represents a help to ANT to appreciate that context is not vague social concept, but rather corresponds to the physical constitution of space that materially affects the outcome of a project.

Even if the synthesized concepts outlined below fail to attract interest, the propositions for mutual inspiration outlined here, are worthy of consideration in my opinion. Therefore this discussion combining Time Geography and ANT even represents a quid pro quo for both frameworks individually.

6.5 Combining Concepts in regard to telepresence

After all this discussion of possible similarities and possible concepts that are alike in both Time Geography and ANT now the time is ripe to actually combine concepts of the two approaches and create new synthesized concepts. I refrain from creating a whole synthesized approach because such an approach is best proposed and created in combination with an empirical study that validates against obvious contradictions. Nevertheless I took the liberty to name these concepts to emphasize that these represent synthesized concepts and not borrowed concepts from Time Geography or ANT respectively. Below follows a presentation of these combined concepts. The presentation style corresponds to the theory chapter in which the main concepts of the two approaches are presented. Therefore let's start with the concept of time.

6.5.1 Time

Time as synthesized concepts draws from both Time Geography and ANT, just like Time Geography's concept, time represents a physical measure of change intrinsically linking it to materiality. Time not being an abstract property of space is a result of it. A suitable name therefore seems *material time.* Material time represents a ordering of events along a defined temporal arrow moving forward.

However human reality is defined to subjective experience, time being no exception to this rule. Therefore the human experience of time should reflect this realization. I propose to call this concept *subjective time*. All past events are subjective in the sense that they represent what Latour (1999a) calls *representation* and *retrofitting*, depending on the strongest interpretation defining which the *right* order of events represents. In addition included in this subjective time is the possibility of multiple interpretations contesting versions of time simultaneously.

Even with this relative concept of time, there still exists a clear directionality of time in the forward direction. The only point of time that actually exists is now, the future is uncertain and the past is subject to retrofitting and representation. Despite all this the directionality allows for the claim that events happen now, giving a concrete sense of time while still accommodating for the relative nature of past events.

Time thereby has a *dual multiplicity* being on the one side physical and precise and on the other hand representing multiple human presentations; relative and multiple. Any kind of human endeavor needs to account for this dual multiplicity in one form or another. In this view telepresence has also a duality of time. The material dimension being when telepresence occurs possible of *simultaneous* action at several locations, as far as permitted by the restriction of physics. But also retaining a subjective experience of time, in that the European morning, is the Australian evening, neither presentation of subjective time is wrong since they correspond to the interpretative framework of the location.

6.5.2 Space

As mentioned previous human experience is always subjective, allowing for a multiple interpretation of the world. This creates uncertainty and multitude of different presentation that actors need to account for, just like ANT claims.

In contrast to this uncertainty there exists only one *material space*. Material space is the only thing that exists, there is no supernatural realm, no social realm no virtual realm all that exists is materiality. What does exist and to a certain degree correlates to these concepts are different modes

of organization of physical space. This *organizational space* represents different constellations of physical space that produce certain properties, virtual space or social spheres represent such properties. Organizational space represents different layers, or topologies that interact with each other or overlap thereby actors' realities stretch over several topologies.

Just like Hägerstrand (2009) claims material space is a product out of all the entities enclosed by it, while organizational space represents modes of ordering of material space. Thereby it represents no separate sphere, only a characteristic of material space. Nevertheless for analytical purposes it's permissible to treat them as a separate spheres representing: virtual space, social space etc. as long as this realization is not lost in the process of analysis. Material space is describable using Euclidean coordinates in addition to allocating it in a time dimension. Concrete example represents Amundsen reaching the South Pole on the 14th of December 1911, representing a defined geographical location with a time datum. While organizational space´s coordinates depend on the structure of the network and the users' utilization of it, as seen in Yin's example of social networks.

Telepresence in this view is a property of the organizational space of computers, phones and other ICT's. This organizational space represents a relatively different kind of space. It is relative in the sense that it has different properties, but still depends on material space to maintain function. Telepresence in this regard is a physical process subjected to the same laws and process as all other forms of interaction.

6.5.3 Time Space Networks

What is the structure of the organizational space and how is it achieved? These modes of ordering represent *time space networks*. These are constructed out of immutable mobiles (except fluids) however the concept of immutable mobile is extended into the temporal dimension. For an immutable mobile to remain stable i.e. immutable it requires stability of constellation also in a temporal dimension. Therefore the immutability extends into four dimensional space (three spatial dimensions + 1 temporal dimension).

These time space networks exist in different topologies having different relation towards each other and different grades of complexities. Just like Mol and Law (1994) recognize that there exist networks inside networks. As recognized above a dual presentation style treating these time space networks separate from material space is possible for analytical purposes. This separate presentation should take the form of Yin's presentation of physical space of a network and the SNS space of social network analysis. Instead of only representing social networks this type of presentation is theoretically applicable to all types of time space networks.

In this view telepresence occurs when several space time networks are utilized simultaneously. As Yin's Case B exemplifies, this utilization is only possible by adhering to the specific network conditions created by the immutable mobiles involved in creating the networks. An email is defined as text based medium, if video or audio properties of information transfer are desired. The mail system needs extensions in forms that these files are attachable, or audio and video players are integrated. Further network-work is necessary to extend the properties of a space time network, in this case telepresence.

6.5.4 Constraint Actors

Action is a result of internal choices of conscious actors and external forces. This results that actors, humans and objects alike represent *constraint actors*, constraint due the effects of material space around them but able to act because of different *degrees of freedom*. Constraint actors have the possibility to choose, if the property of consciousness is created by particular time space network. A human, an animal or computer program programmed for choice all posses this property, however this complex ability is not something different from material space; it's a *result* of a complex ordering of material space.

Nevertheless once this ability is present balancing relation results, between internal choice and external forces resulting in different degrees of freedom. A stone is entirely dependent on the shape of material space around it, while a human represents a higher degree of freedom and therefore is able to choose. However the choices available to the human are dependent on the material space around it. A falling human choice to hit the ground or not is outside the degree of freedom, the only possibility that is possible represents how the ground is encountered.

This power struggle between internal choices and external forces allows for the concept of impossibility. When external forces dominate internal choice different theoretical possible choices become a practical impossibility. Yin´s phone example represents an analogy to this notion, despite the possibilities created by the phone, the intentions of the person to meet etc. etc. the physical separation and the inability to physically take themselves to the meeting denied a F2F meeting. Telepresence is caught in the same power struggle, on one side enabling action (like Case A) but on the other side necessitating particular usage conditions (like in Case B) and creating specific problems related to these conditions (like in Case C).

6.5.5 Change

Change in this synthesized concept is both dependent actors actively manipulating the material space in order to facilitate change and the external forces influencing the time space networks. Because the precursors to material space can in themselves cause change, here I am alluding to physical laws and affordances enabled by the objects themselves, all in accordance with the material turn.

Constraint actors are able to manipulate material space according to the degrees of freedom they receive from particular time space networks. A concrete example represents a human trying to fell a tree. If the tree's trunk is larger than a certain diameter the unaided human is unable to fell the tree. However by utilizing an axe, a time space network of iron atoms in the shape of an axe, the degrees of freedom for the human are increased and now the action of felling the tree is enabled.

Telepresence by ICT represents a means of enabling new kind information transfer between individuals. With the help of telepresence new properties are explored, not possible before. This makes telepresence by ICT a qualitative new property of human interaction on the same level as the invention of fire making tools and steam power created new ways for humans to act. Before becoming far too speculative I would like to end the discussion about the synthesized concepts here. The discussion how these concepts relate to ICT continues in the next chapters concluding remarks.

7. Concluding Discussion

This represents the final chapter of this study. I intend to use this space for reflecting on the aspects learned and the method of the study. I conclude with addressing some general thoughts of mine about materiality and future work.

7.1 Conclusion

The whole study from the start to finish represented a highly specialized enterprise. Every step of the way raised issues requiring specialized solutions. These represented the special type of content analysis due to the absence of sufficient studies in both approaches about the same subject, the disputed status of theory of both Time Geography and Actor-Network Theory (ANT), as well as the multiplicity of interpretations of Time Geography and ANT and so forth to just name a few. Therefore this study represented a constant struggle finding solutions to problems usually taken for granted. After managing to find solutions to all these difficulties I like to take the liberty to present the conclusion in a similar specialized form of presentation. The conclusion represents half hypothetical example half presentation of the synthesized concepts.

The synthesized concept outlined in 6.6 relate to Information and Communications Technologies (ICT) in several ways. ICT represents a virtual space, a form of organizational space being a property of material space. Therefore a dual presentation approach to this particular phenomenon seems beneficial.

Social networks, telephones, computers or other forms of ICT represent space time networks with corresponding properties allowing for the creation of organizational space, i.e. virtual space. The distance inside this virtual space is not metric but depending on semiotic patterns. Yin's approach of cluster analysis of these semiotic patterns alongside their physical presentation in material space appears appropriate to analyze the interaction of these kinds of spaces in accordance with the material turn.

Actors that engage in ICT and in general represent constraint actors that have different degrees of freedom according to the surrounding constitution of space. The utilization of ICT raises the degree of freedom of the actors enabling them to engage in distant communication maintaining friendships despite geographical separation. Nevertheless external forces retain the possibility to overwhelm these degrees of freedom forcing the actor down a restricted path of choices. High speed internet access is useless for the maintaining of friendships when one person spilled a glass of water over the computer destroying the circuitry. If that particular scenario occurs I am doubtful that the person in question finds comfort in the realization that everything is material even our anger, both the source and the effect.

7.2 Reflections

This part of the discussion represents my personal reflections upon the conducted study and the particular findings.

A big surprise to me represented the usage of Time Geography in the studies and the type of criticism addressed both in the three studies and in the literature in general. Almost all arguments or criticism exclusively departed from understanding of classical Time Geography. Obviously other interpretations of Time Geography exist beside Hägerstrand's concepts from the seventies, however

regarding practical implementation everything exclusively referred to this body of work. Different interpretations of Time Geography possibly result in a different discussion as the one outlined above. However the classical understanding of Time Geography by far represented the biggest single interpretation, therefore it seemed reasonable to base the discussion on this interpretation.

Within the concept of classical Time Geography ANT definitely adds understanding to the particular choice of life paths. All three studies faced difficulties attempting interpretation of particular outcomes, easily understood with ANT. In addition the interconnectedness of virtual and physical realm appeared almost self evident for all three studies. All three studies recognized its importance and adjusted accordingly. Therefore claiming that it represents a problem for Time Geography's understanding, like Schwanen (2007) claims, is difficult to judge from these findings. Each study found different ways adopting. This adopting of different solution possibly infers the existence of a problem, because if no apparent problem is present why adopt different solutions?

All three studies recognized different difficulties with the Time Geographic framework they applied and tried to accommodate accordingly. What is encouraging by their different attempts is that all attempts made by the three studies to incorporate other approaches are all potentially covered by ANT. The strongest example of this kind of relationship was probably Pultar's incorporation of social capital. The way he described it allowed for almost one to one reinterpretation as the concept of ANT's alliance building. Yin probably succeeded best of all three studies to conceptualize and describe telepresence and its effect. Her incorporation of social network analysis allowed her to recognize network structure in addition her combination with particular geographical location retained geographical specific focus. This duality in presentation seemed very fruitful in retaining an understanding of the network structure but not neglecting geographical particularities. The social network analysis style she adopted perfectly translated into ANT without any major modifications, further corroborating the assumption of a possible combination of Time Geography and ANT.

With the whole studies finding in mind the possibility to create an integrated approach out of Time Geography and ANT seems very likely. The synthesized concepts should represent a first step in this direction. These potentially add crucial understanding to geographical inquiry because they are similar to the approaches employed by the three studies that they regarded as useful and insightful.

Regardless if such an integrated approach materializes both theories definitely represent inspiration for each other. To just name one possibility; the particularity appreciation of space Yin applied in her dual presentation approach integrated seamless with the network analysis very similar to ANT. This poses a possible opportunity for ANT to address the criticism raised by Oudshoorn (2012) that ANT is missing a particular appreciation of space.

7.3 Discussion of the Methodology

The design of the selection process deliberately opened for a wide range of studies using Time Geography, by only including the one search phrase *time geography*. The resulting studies still all applied quantitative methods and classical Time Geography. As mentioned in this discussion section before the argument proposed here of beneficial combination for Time Geography with ANT may not apply to Time Geography as whole, but it certainly applies to the type of classical inspired Time Geography discussed in this study. With the selection process in mind, there is a possibility that other types of interpretations of Time Geography are applied to the understanding of ICT, but they didn't surface in the widespread search.

Despite that the studies mainly applied classical interpretation of Time Geography. For the theoretic discussion and the synthesis of the concept I choose to incorporate the entirety of Time Geography, utilizing the concept deemed most useful and not most popular.

The dual description of the reading of the case studies proved a greater challenge than anticipated. This type of methodology required great amount of details allowing for the creation of the ANT version of the situation described. The central tenant of ANT to *follow the actor* proved difficult at times because of the lack of information. In these cases the author relied heavily on inference from the general knowledge of Time Geography and of the ICT cases discussed. The type of presentation encountered retained too few details to outline the entire network, clearly representing a weakness of the chosen methodology. Despite these deficiencies the results appears reliable because all three ANT cases described resulted in a fairly similar picture of network building and coordination. As expected since all of them dealt with similar forms of ICT, mainly the internet. In addition the concept that did allowed for detailed description like the Pultar's use of social capital and Yin's social network analysis assumed the shape of textbook ANT cases, making them easy to recognize and their interpretation reliable. So despite the problems faced here, I am very confident in the findings of this study inside the framework that was posed.

7.4 General Discussion

I am aware that one of the delimitations constituted not to question the material type of presentation, since the study only aimed at the comparison of two types of material approaches. Nevertheless I think it is a good time to break this self imposed taboo now and openly discuss the choice and value of such an approach.

ANT hardly gains popularity when denying traditional social explanations from scholars championing these types of approaches, since it is flat out denying their usefulness. Latour (2007) lessened the absolutism in this claim, acknowledging relevance to certain traditional social explanations. However he still steadfastly advocates that these explanations need material representations. To paraphrase him *yes, social ties exist, but what are they made of?* This fixation to materiality represents a form of absolutism difficult to accept for some traditional schooled social scholars and human geographers; however it is in accordance with the natural sciences.

The cognitive philosopher Daniel Dennett, famous for writing *Consciousness Explained* and *Darwin's Dangerous Idea*, in an interview with the newspaper *Corriere Della Sera* explained this material view of human nature. The next day the newspaper printed the article with the headline:

Sì, abbiamo un'anima. Ma è fatta di tanti piccoli robot (Corriere Della Sera 1997)

Translated to English is means: *"Yes, we have a soul, but it's made of lots of tiny robots."* Dennett is referring to the shared materiality of all beings, human or not. With this realization comes no dramatic shift in reality, only the realization that human are subject to the same material restriction just like anything else. This corresponds to the claim that consciousness is a result of complex time space networks not a separate property.

This type of material presentation is carefully avoided by social scholars and human geographers, because of fear to degenerate into determinism, determinism being regarded as negation of free will. However Dennett (2003) claims this fear is unfounded free will is compatible with determinism. He calls this concept *compatibilism with an evolutionary twist*, claiming that free will evolved and although our action might be pre-determined out of a strict physical sense. Because of human evolved abilities to choose between different pre-determined scenarios, free will remains free. Free will in this scenario is about the freedom to make decisions without duress, as opposed to an impossible and unnecessary freedom from causality itself according to him (Dennett 2003).

This type of materiality presentation resonates well with both Time Geography and ANT. They accept the claim explaining social phenomena as material, because even if they are *social* they need physical resonance to have an effect (Hägerstrand 2009). Obviously the study focused on materiality of representation, but no situation required turning to social explanation or any other type of immaterial realm for explanation. Materiality alone was more than able to account for everything. So to answer the question if it is possible to coherently describe the world in material terms, this study is leaning towards a *yes*.

Where to go from here? In the introduction I stated that the intention of this study represented the contribution to the creation of a viable framework describing ICT and its connected telepresence understanding its implications. As seen in this study the combination of Time Geography and ANT appears as a viable option for such a framework, and the synthesized concepts represent a first step in that direction. The next logical step represents the creation of such framework and its practical application to an empirical case. Seeing social systems as material entities and describing them in a fashion to *outline the whole network* represents more than a fair challenge, Latour (2007) concurs claiming that outlining the whole network is very hard and challenging indeed, but not impossible. So please allow my grand dreams just like Jules Verne dream of flying to the moon and diving in the deepest oceans that were formerly regarded as impossible.

René Brauer

2012-06-11

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9. Appendix

9.1 Preliminary Subject Search

Time Geography

Note: Artiles I find intresting will be in bold
red = missing from libary

* as interpreted by me after reading the abstract

ID	Titel	Author	Date	Keywords	Subject*	Serach Engine	Serach Word
1	**A GIS-based time-geographic approach of studying individual activities and interactions in a hybrid physical–virtual space**	**Shih-Lung Shaw, Hongbo Yu**	**2009**	**travel pattern, Space–time GIS**	**Time geography, Hybrid physical–virtual space, Activity and GIS Time Geography Approach**	**Google Scholar**	**Time Geography**
2	**A Time Geography Approach to the Visualisation of Sport**	**A.B. Moore, P. Whigham, A. Holt, C. Aldridge and K. Hodge**	**2002**		**Visualization of Time Geography to Rubgy**	**Google Scholar**	**Time Geography**
3	Gender differences in space-time constraints	Mei-Po Kwan	2000		Gender Studies, Activity-Travel Patterns	Google Scholar	Time Geography
4	**Time Use among People with Psychiatric Disabilities Implications for Practice**	**Mona Eklund**	**2009**	**occupational balance, health, assessment, intervention**	**Time Usage, People with Mental Dissabilties**	**PubMed**	**Time Geography**
5	Access to Transportation and Health Care Utilization in a Rural Region	Thomas A. Arcury, John S. Preisser, Wilbert M. Gesler, James M. Powers	2006		Accesibilty to Health Care, in Rural Setting	PubMed	Time Geography
6	Navigating the time–space context of HIV and AIDS daily routines and access to care	Lois M. Takahashia, Douglas Wiebeb, Rigoberto Rodriguezc	2001	USA	Accesibilty to Health Care, people living with AIDS/HIV	PubMed	Time Geography
7	THE STUDY OF HUMAN BEHAVIOR AND SCHISTOSOMIASIS TRANSMISSION IN AN IRRIGATED AREA IN MOROCCO	S. WATTS, K. KHALLAAYOUNE, R. BENSEFIA, H. LAAMRANI, B. GRYSEELS	1998	Bschistosomiasis, irrigation, water contact, time geography, household, gender	Rural Water Usage in Development Studies, Gender	PubMed	Time Geography
8	An Ecological Approach To Health Risk: A Case Study of Urban Elderly Homeless People	Fay E. Reilly,	1994		health risk elderly, homeless	PubMed	Time Geography
9	A spatiotemporal partitioning approach for large-scale vehicle routing problems with time windows	Mingyao Qi, Wei-Hua Lin, Nan Li a, Lixin Miao	2012	Vehicle routing with time windows. Logistics, Time geography, Spatiotemporal distance	Logistics, Transportation	Scopus	Time Geography
10	Analytical methods for error propagation in planar space–time prisms	Tetsuo Kobayashi, Harvey J. Miller, Walied Othman	2011	Spatial error Error propagation analysis Geographic information science Time geography Space–time prisms	assesing error progation in time-space prism creation	Scopus	Time Geography
11	Constructing a Near Real-time Space-time Cube to Depict Urban Ambient Air Pollution Scenario	Tianfang B. Fang, Yongmei Lu	2011		Air Polution Modeling	Scopus	Time Geography
12	Time-geographic density estimation for home range analysis	Joni A. Downs, Mark W. Horner & Anton D. Tucker	2011	time geography; density estimation; sea turtle; moving objects	Tracking Animals Home Range, Digital Model	Scopus	Time Geography
13	Modelling potential movement in constrained travel environments using rough space–time prisms	Matthias Delafontaine, Tijs Neutens & Nico Van de Weghe	2011	time geography; space-time prism; uncertainty; obstacles; accessibility	accesbility	Scopus	Time Geography
14	Running to stay in place: the time-use implications of automobile oriented land-use and travel	Steven Farber, Antonio Páez	2011	Time-geography, Automobility, Activity participation, Social interaction, Socially sustainable transportation	Transportation Impact on the Activty Space	Scopus	Time Geography
15	**The impact of opening hours on the equity of individual space–time accessibility**	**Matthias Delafontaine a, Tijs Neutens, Tim Schwanen, Nico Van de Weghe**	**2011**	**Accessibility, Equity, Opening hours, Time geography**	**Temporeal Accesbility**	**Scopus**	**Time Geography**
16	No Place to Live: The Uninhabitable Body	Mary E. Sonntag	2011		Identy	Scopus	Time Geography
17	**Exploratory data analysis of activity diary data: a space–time GIS approach**	**Jie Chen, Shih-Lung Shaw, Hongbo Yu, Feng Lu, Yanwei Chai, Qinglei Jia**	**2011**	**Time geography, Space–time GIS, Activity diary data**	**Human movement GIS**	**Scopus**	**Time Geography**
18	Potential effects of ICT on face-to-face meeting opportunities: a GIS-based time-geographic approach	Ling Yin, Shih-Lung Shaw, Hongbo Yu	2011	ICT, Face-to-face meeting, Time geography, Space–time GIS, Activity-based model	Mapping impacts of Human Interaction In virtual and face to face	Scopus	Time Geography
19	Neighborhoods, daily activities, and measuring health risks experienced in urban environments	Luke A. Basta, Therese S. Richmond, Douglas J. Wiebe	2010	Neighborhood, Urban health, Exposure misclassification, Bias, Activity patterns ,Violence, Time geography, Adolescents, Space, USA	urban health risks	Scopus	Time Geography
20	Directed movements in probabilistic time geography	Stephan Winter & Zhang-Cai Yin	2010	probabilistic time geography; uncertainty; spatiotemporal reasoning; moving objects	movement patterns	Scopus	Time Geography
21	A sensitive indicator of regional space–time accessibility	Zhixiang Fang , Shih-Lung Shaw & Qingquan Li	2010	space–time accessibility; time–geography; spatial pattern; region	accesbility	Scopus	Time Geography
22	Co-ordinating Passages: Understanding the Resources Needed for Everyday Mobility	Peter Peters , Sanneke Kloppenburg & Sally Wyatt	2010	Everyday; mobile phones; Netherlands, passage; project; exchange; resources;hypermobility; methodology	mobility	Scopus	Time Geography
23	**Development of probability density functions for future South American rainfall**	**Tim E. Jupp, Peter M. Cox, Anja Rammig, Kirsten Thonicke, Wolfgang Lucht and Wolfgang Cramer**	**2010**	**Amazonia, Bayesian statistics, climate change, forest dieback, probability,vegetation modelling**	**climate change probality statistic**	**Scopus**	**Time Geography**
24	Finding a Path: Investigating the Labour Market Trajectories of High-Skilled Immigrants in Denmark	Anika Liversage	2009	High-Skilled Migration; Labour Market; Time-Geography; Biographical Method; Denmark	migration	Scopus	Time Geography
25	A new approach for modeling spatio-temporal events in an earthquake rescue scenario	A.R. Vafaeinezhad, A.A. Alesheikh, A.A. Roshannejad and R. Shad	2009	Rescue teams, spatio-temporak activties, time geography, heuristics programming, earthquake	rescue activity erathquake	Scopus	Time Geography
26	Examining School Routines Using Time-Geography Methodology	Diane Hammon Kellegrew, Ulla Kroksmark	1999	Children with disabilities, time use, social skills, low vision, occupational therapy, physical therapy	education routines	Chinal	Time Geography
27	Levels of complexity in patterns of daily occupations: relationship to women's well-being	Lena-Karin Erlandsson & Mona Eklund	2011	Daily occupations, Time geography, Dual workload, Health	gender helth	Chinal	Time Geography
28	User-Centred Time Geography for Location-Based Services	Martin Raubal, Harvey J. Miller, Scott Bridwel	2004	Time geography, affordances, location-based servic- es, human decision-making	loclization	JSTOR	Time Geography
29	**SocietySpace-Time Modeling of Grizzly Bears**	**Leonard D. Baer and David R. ButlerReviewed**	**2000**		**zoology**	**JSTOR**	**Time Geography**
30	Home as a Pocket of Local Order: Everyday Activities and the Friction of Distance	Kajsa Ellegård and Bertil Vilhelmson	2004	Time geography, mobilty, home, activity, household	mobility	JSTOR	Time Geography
31	A CITY IN MOTION: TIME-SPACE ACTIVITY AND MOBILITY PATTERNS OF SUBURBAN INHABITANTS AND THE STRUCTURATION OF THE SPATIAL ORGANIZATION OF THE PRAGUE METROPOLITAN AREA		2007	time geography, time-space, structuration, activity, and mobility patterns, postcommunist city, suburbanization, urban and metropolitan change	urban mobility	JSTOR	Time Geography
32	Paths in Transnational Time-Space: Representing Mobility Biographies of Young Swedes	Lotta Frändberg	2008	time-geography, biography, mobility, transnationalism, young people, Sweden.	mobility	JSTOR	Time Geography
33	A teaching approach to time-geography: Some results of an educational experiment	Mar´ia A´ ngeles D´ıaz-Muñoz, Mar´ia Jesu´s Salado-Garc´ia & Concepcio´n D´ıaz-Castillo	1999	time-geography, education, students	education routines	Springer Link	Time Geography
34	Daily life of elderly women in a rural area in The Netherlands	Joos Droogleever Fortuijn	1999	elderly women, rural areas, social activities, support networks, time-geography	mobility	Springer Link	Time Geography
35	Individual accessibility and distance from major employment centers An examination using space-time measures	J. Weber	2003	Accessibility, time geography, distance, monocentric model	accessbility	Springer Link	Time Geography
36	Urban activity spaces: Illustrations and application of a conceptual model for integrating the time and space dimensions	TRACY H. NEWSOME, WAYNE A. WALCOTT & PAUL D. SMITH	1998	activity space, ellipses, space-time geography	activity space	Springer Link	Time Geography
37	A three-dimensional network-based space–time prism	Tijs Neutens, Nico Van de Weghe. Frank Witlox, Philippe De Maeyer	2008	Time geography Space–time prism GIS CAD	GIS	Springer Link	Time Geography
38	Time-Space Diaries	T. Schwanen,	2009		diaries	ScienceDirect	Time Geography
39	Using experiencedactivityspacestomeasurefoodscapeexposure	Yan Kestens AlexandreLebel, MarkDaniel, MariusThe´ riault , RobertPampalon	2010	Exposure, Foodscapes, Activity space, Travel surveys, Space-time geography	lifestyle food	ScienceDirect	Time Geography
40	Time Geographic Analysis	M. Dijst,	2009		time space usage	ScienceDirect	Time Geography
41	**Visualizing energy consumption activities as a tool for developing effective policy**	**Jenny Palm and Kajsa Ellegård**	**2011**	**Policy, household, time diary, visualization, energy, feedback.**	**energy household**	**Wiley Online Libary**	**Time Geography**
42	Sequence Alignment as a Method for Human Activity Analysis in Space and Time	Noam Shoval and Michal Isaacson	2007		human time usage	Wiley Online Libary	Time Geography
43	Bread or Chainsaws? Paths to Mobilizing Household Labor for Cooperative Rural Devegprnent in a Oaxacan Village (Mexico)	Tad Mutersbaugh	2008	Oaxaca, Mexico, indigenous peoplesxhinantec, peasant households,gender, political economy, production cooperatives, rural development	devlopment rural	Wiley Online Libary	Time Geography
44	A Space-Time GIS Approach to Exploring Large Individual-based Spatiotemporal Datasets	Shih-Lung Shaw, Leonard S Bombom, Hongbo Yu	2008		GIS	Wiley Online Libary	Time Geography
45	Gender differences in space-time constraints	Mei-Po Kwan	2000		gender travel	Wiley Online Libary	Time Geography
46	CREATIVITY IN TIME AND SPACE	Gunnar Törnqvist	2004	Creativity, renewal, milieux, common characteristics, mobility, Nobel laureates, life path in time and space	creativity	Wiley Online Libary	Time Geography
47	Movement beyond the snapshot – Dynamic analysis of geospatial lifelines	Patrick Laube, Todd Dennis, Pip Forer, Mike Walker	2007	Geospatial lifelines; Mobile trajectories; Movement; Context operators; Time geography	geospatial lifelines	Scopus	Time Geography
48	**Household routines—A time-space issue: A theoretical approach applied on the case of water and sanitation**	**Helena Krantz**	**2006**	**Culture; Environment; Households; Resource use; Routines; Sustainability; Theory; Time-space; Water and sanitation**	**recource managment**	**Scopus**	**Time Geography**
49	Your little doorstep is my wall: A personal experience of living in a disabling society	Anders Löfgren	2007	disability, impairment, time geography		Scopus	Time Geography
50	WRESTLING AS A SYMBOL FOR MAINTAINING THE ORDER OF NATURE IN ANCIENT MESOPOTAMIA	JOSEPH AZIZE	2002		history	Scopus	Time Geography

Actor-Network Theory

Note: Artiles I find intresting will be in bold
red = missing from libary

* as interpreted by me after reading the abstract

ID	Titel	Author	Date	Keywords	Subject*	Serach Engine	Serach Word
1	Actor-Network Theory, organizations and critique: towards a politics of organizing	Rafael Alcadipani and John Hassard	2010	Actor-Network Theory, ANT and After, critical performativity, management and organization, studies, political ontology	Organziation planing	Google Scholar	Actor Network Theory
2	Actor-Network Theory as a Critical Approach to Environmental Justice: A Case against Synthesis with Urban Political Ecology	Ryan Holifield	2009	environmental justice, actor-network theory, Marxism, urban political ecology	Envrionmental Justive	Google Scholar	Actor Network Theory
3	WILDLIFE TOURISM, SCIENCE AND ACTOR NETWORK THEORY	Kate Rodger	2009	actor-network theory, wildlife tourism, sociology of science	Widlife Tourism	Google Scholar	Actor Network Theory
4	Better Business-IT Alignment Through Enterprise Architecture: An Actor-Network Theory Perspective	Anna Sidorova and Leon A. Kappelman	2011	Enterprise Architecture, Actor-Network Theory, Politics, IT Architecture, Socio-Technical, Business-IT Alignment, Strategy	Enterprise Architecture	Google Scholar	Actor Network Theory
5	**Topologies of climate change: actor-network theory, relational-scalar analytics, and carbon-market overflows**	**Anders Blok**	**2010**		**Climate Change**	**Google Scholar**	**Actor Network Theory**
6	Koordination und Ordnungsbildung in der Akteur-Netzwerk-Theorie	Annemarie Mo	2010		Disscusion of ANT	Google Scholar	Actor Network Theory
7	Developing the Mobile Service Applications of a Micropayment Platform(MPP): the Perspective of Actor-Network Theory	Jen Wei Chen, Hsiao-Chi Wu, Ching-Cha Hsieh	2011	Micropayment, mobile payment, Actor Network Theory, Near Field Communication	Development of Micropayment Platforms	Google Scholar	Actor Network Theory
8	Nonhuman charisma	Jamie Lorimer	2007		Biodiversity Conservation	Google Scholar	Actor Network Theory
9	An Actor-Network Theory Analysis of Policy Innovation for Smoke-Free Places: Understanding Change in Complex Systems	David Young, PhD, Ron Borland, PhD, and Ken Coghill, PhD	2010		Public Health Smoking	Google Scholar	Actor Network Theory
10	**Information infrastructure for inter-organizational mental health services: An actor network theory analysis of psychiatric rehabilitation**	**Toomas Timpka, Magnus Bång , Tom Delbanco, Janet Walker**	**2006**	**Health informatics; Inter-organizational health services; Information infrastructure; Case study methods; Actor network theory**	**Orgnisation of Psychatric Care**	**PubMed**	**Actor Network Theory**
11	**Actor-Network Theory: a tool to support ethical analysis of commercial genetic**	**Bryn Williams-Jones & Janice E. Graham**	**2010**		**Genetics**	**PubMed**	**Actor Network Theory**
12	Social Worlds, Actor-Networks and Controversy: The Case of Cholesterol, Dietary Fat andHeart Diseas	Karin Garrety	1997		Dietary Recommendations Controversies	PubMed	Actor Network Theory
13	**A patchwork of people, pots and places: Material engagements and the construction of 'the social' in Hamwic (Anglo-Saxon Southampton), UK**	**Ben Jervis**	**2011**	**Anglo-Saxon, Actor–Network Theory, biography, engagement, Hamwic, pottery**	**Archaeology**	**Scopus**	**Actor Network Theory**
14	Multiple architectures and the production of organizational space in a Finnish university	Tuomo Peltonen	2011	Finland, Universities, Architecture, Space utilization, Organizational history, Users	Architectural Development and Organizational Impact	Scopus	Actor Network Theory
15	Families and food: beyond the "cultural turn"?	P. Jackson	2010		Cultural Impact on Social Geography	Scopus	Actor Network Theory
16	What Holds us Together? Analyzing Biotech Field Formation	Jackeline Amantino de Andrade	2011	Biotechnology; organizational field; actor-network theory; interorganizational relations; institutional theory; innovation	Biotechnology	Scopus	Actor Network Theory
17	On Actor-Network Theory and landscape	Casey D Allen	2011	Field experience, landscape theory, Actor-Network Theory, nature–society dialectic, heterogeneity, consumption	Landscapes	Scopus	Actor Network Theory
18	**Actor-network theory as a reflexive tool: (inter)personal relations and relationships in the research process**	**Rebecca Sheehan**	**2011**	**actor-network theory, (inter)personal relations and relationships, reflexivity, qualitative research, field work**	**Etnography of Reserach Projects**	**Scopus**	**Actor Network Theory**
19	SAO network analysis of patents for technology trends identification: a case study of polymer electrolyte membrane technology in proton exchange membrane fuel cells	Sungchul Choi, Janghyeok Yoon, Kwangsoo Kim, Jae Yeol Lee, Cheol-Han Kim	2011	Technology Subject-Action-Object (SAO) Function Patent mining Patent analysis Technology trends analysis Co-word analysis Actor network theory	Technology	Scopus	Actor Network Theory
20	Generating, comparing, manipulating, categorizing: reporting, and sometimes fabricating data to comply with No Child Left Behind mandates	Jill P. Koyama	2011	qualitative; actors institutions	Education Policy Practice	Scopus	Actor Network Theory
21	**Milk in the Multiple: The Making of Organic Milk in Norway**	**Stig Larssæther**	**2010**	**Organic agriculture Moral object Conventional milk Actor-network theory Agency**	**Organic Agriculture Buisness**	**Scopus**	**Actor Network Theory**
22	Innovation, strategy and identity: a case study from the food industry	Thomas Hoholm, Fred H. Strønen	2011	Innovation, Corporate identity, Strategy, Process, Practice, Actor network theory, Food industry, Norway	Food Industry, Corporate Identy	Scopus	Actor Network Theory
23	Materializing ideas: A socio-material perspective on the organizing of cultural production	Sara Malou Strandvad	2011	actor–network theory, attachment, co-production, immutable mobiles, mediation, mutable mobiles, production of culture, sociology of art, socio-materiality	Movies, Manifestions of Cultural Ideas	Scopus	Actor Network Theory
24	Games are not convergence: The lost promise of digital production and convergence	Casey O'Donnell	2011	actor-network theory, convergence, cross-media, videogame developers, videogame development, videogames	Viedogames, Modern Media Production Practice	Scopus	Actor Network Theory
25	Clash of the eco-sciences: carbon marketization, environmental NGOs and performativity as politics	Anders Blok	2011	performativity of economics; materialist politics of techno-science; carbon markets; transnational environmental NGOs; climate justice	Climate In/Justice	Scopus	Actor Network Theory
26	The landscape technology of spate irrigation amid development changes: Assembling the links to resources, livelihoods, and agrobiodiversity-food in the Bolivian Andes	Karl S. Zimmerer	2011		Livlehoods	Scopus	Actor Network Theory
27	The Eltroxin controversy: Risk and how actors construct their world	John Gardner & Kevin Dew	2011	risk; risk communication; risk management; risk perception; drug regulation; Eltroxin	Public Health Controversy	Scopus	Actor Network Theory
28	**Managing predators, managing reindeer: contested conceptions of predator policies in Finland's southeast reindeer herding area**	**Hannu I. Heikkinen, Outi Moilanen, Mark Nuttall, Simo Sarkki**	**2011**		**Envrionment Managment and Co-exsitance**	**Scopus**	**Actor Network Theory**
29	'Child in Need' Plans: Tools for Family Empowerment	Tony Stanley	2010	'Child in Need' plans; Actor Network Theory; professional anxiety; family empowerment	Social Work Non-human Dimension	CHINAL	Actor Network Theory
30	When you smell smoke...': 'risk factors' and fire safety in action.	Lloyd M ; Roen K	2002	risk, fire safety, knowledge translation	Fire-safety Knowledge Pratice, Households Firedepartment Interaction	CHINAL	Actor Network Theory
31	The Camera as an Actor: Design-in-Use of Telemedicine Infrastructure in Surgery	MARGUNN AANESTAD	2003	actor-network theory, alignment, configuration, design-in-use, health care, inscriptions, telemedicine, translations, video-mediated communication, work practice	Health Care Technology Development	Springer Link	Actor Network Theory
32	The role of socio-environmental networking in the sustainability of rain-fed agriculture in the coastal savanna of Ghana	Michael O'Neal Campbell	2004	actor network theory, coastal savanna, Ghana, rain-fed farming, socio-environmental networking	Devlopment (Field) Studies, Agriculture	Springer Link	Actor Network Theory
33	Student trajectories in physics: the need for analysis through a socio-cultural lens	Mara Zapata	2010	Cultural capital Socio-cultural theory Actor network theory Social tools Situated learning	Education, Trajectories of Students through their Education	Springer Link	Actor Network Theory
34	Systems and Organizations: Distal and Proximal Thinking	Robert Cooper	1992	Actor-network theory; local practices; materialized morality; writing technology; topography; networks; digital technology	Organization Organizing	Springer Link	Actor Network Theory
35	Agricultural transitions in the context of growing environmental pressure over water	Stephen P. Gasteyer	2008	Actor network theory Advocacy coalitionframework Agricultural change Agricultural policy Conservation policy Structure of agriculture Water policy Water quality and agriculture	Agriculture Practice	Springer Link	Actor Network Theory
36	Religious values informing halal meat production and the control and delivery of halal credence quality	Karijn Bonne and Wim Verbeke	2008	Actor-Network theory, Conventions theory, Halal, Islam, Meat, Quality control, Religion, Supply chain	cultural, organisation	Springer Link	Actor Network Theory
37	Lessons learned from an empirical study of the early design phases of an unfulfilled innovation	Je´re´my Legardeur • Jean Franc¸ois Boujut • Henri Tiger	2010	Innovation Empirical study Socio-technical approach Actor-network theory Interface actor Idea lifecycle management	Internet	Springer Link	Actor Network Theory
38	Diving in magma: how to explore controversies with actor-network theory	Tommaso Venturini	2010	actor-network theory, cartography of controversies, observation methods, public understanding of science, representations of science, scientific controversies, studies of science and technology	How to Cartograph Controversies	SAGE	Actor Network Theory
39	Technological Choices in International Environmental Negotiations: An Actor–Network Analysis	Amandine J. Bied	2010	actor–network theory, technological issues, biotechnology, bioprospecting, intentions/actions	Bioprospecting Technology and Policy	SAGE	Actor Network Theory
40	Exchange studies as actor-networks: Following Korean exchange students in Swedish higher education	Song-ee Ahn	2011	actor-network theory, exchange students, exchange studies, internationalization of higher education, study abroad	Education, Exchange Students Experience	SAGE	Actor Network Theory
41	**When Alcohol Acts: An Actor-Network Approach to Teenagers, Alcohol and Parties**	**JAKOB DEMANT**	**2009**	**actor-network theory, alcohol, focus groups, gender, sexuality, social theory, youth**	**Publich Health, Teenagers Drinking Behaviour**	**SAGE**	**Actor Network Theory**
42	Progress in Physical Geography	Casey D. Allen, Chris Lukinbeal	2011	actor-network theory, fieldwork, philosophy of science, RASI, rock art stability index, weathering pedagogy	Pedagogy Pratice in Geology	SAGE	Actor Network Theory
43	**Blowing against the wind—An exploratory application of actor networkt heory wind energy to the analysis of local controversies and participation processes in wind energy**	**Eric Jolivet , EvaHeiskanen**	**2010**	**Wind power, Controversy, Actor-network theory**	**Wind Energy Implementation Practice**	**ScienceDirect**	**Actor Network Theory**
44	Restoring balance: How history tilts the scales against privacy. An Actor-Network Theory investigation	Bill Bonner , Mike Chiasson, Abhijit Gopal	2009	Privacy, Balance, Actor-Network Theory, History, Historical investigation, Fair information principles	Historic Analysis of Personal Data Usage Pratice	ScienceDirect	Actor Network Theory
45	Actor-network theory and stakeholder collaboration: The case of Cultural Districts	Michela Arnaboldi, Nicola Spiller	2011	Actor-network theory, Cultural District, Stakeholder collaboration, Sustained value creation	cultural studies	ScienceDirect	Actor Network Theory
46	E-government policy and practice: A theoretical and empirical exploration of public e-procurement	Catherine A. Hardy, Susan P. Williams	2008	E-government; E-procurement; Actor network theory; Social construction of policy	internet policys	ScienceDirect	Actor Network Theory
47	Knowledges in action: an actor network analysis of a wetland agri-environment scheme	Jacquelin Burgess, Judy Clark, Carolyn M. Harrison	2000	Agri-environment schemes; Actor network theory; Wetland conservation; Farmers	Agriculture and Conservation Practice	ScienceDirect	Actor Network Theory
48	Information technology as a change actant in sustainability innovation: Insights from Uppsala	Fredrik Bengtsson, Pär J. Ågerfalk	2011	sustainability information system, Green IT, Actor network theory, Action research, Case study,Literature review	Offical IT Technology implementation	ScienceDirect	Actor Network Theory
49	Life histories in cyberspace: life writing as a development tool for rural women	Donna D. Rubinoff	2005	Actor-network theory; Autobiography; Testimonio; Information and communication technology (ICT); Transnational networks; Gender and development; Central America	Gender and Devlopment	ScienceDirect	Actor Network Theory
50	**The rise of community wind power in Japan: Enhanced acceptance through social innovation**	**Yasushi Maruyamaa, Makoto Nishikidob, Tetsunari Iidac**	**2007**	**Social innovation; Community wind power; Actor network theory**	**Community Wind Energy Projects**	**ScienceDirect**	**Actor Network Theory**

9.2 Case Study Search

Database Name

Selection Process:

Step 1:	Conducting the database search with key terms
Step 2:	These are the things I will be looking for when I manually search through titles of the dissertations
Step 3:	When something attracts my attention, I will further analysis the abstract

restrictions:	Language, English, German, Swedish	
Keywords:	"time geography " (eng)	"tidsgeografi" (sv)
	"aika maantiede" (fin)	"tid geografi" (dk/now)
	"Zeitgeographie" (de)	
Looking for:	Dissertations & Theses	
published after:	2000	

Selection criteria

It must be a time geographic study

Key Term combinations for respective language

english	**swedish**	**german**	**further possible combinations**
telepresence			
internet	internät	Internet	
phone	telefon	Telephone / Handy	normal and mobile phones
information age	informationsålder	Informationszeitalter	
virtual	virtuell	virtuelle	virtual reality, virtual space, virtual communication etc.

World wide: search conducted on the 2010-03-02

Pro Quest	America and other	http://search.proquest.com/index

time geography	361

Note:

The following databases had no options to select for, date / theses and dissertations

Therefore the hits showed below are as of now, not sensitive to these restrictions!!!!

Karlsruher Virtueller Katalog	World	http://www.ubka.uni-karlsruhe.de/kvk.html
Counties and Forums excluded:		Finland, World Cat, Britain, Norway, Sweden, Google Books
tidsgeografi	39	

Zeitgeographie	93
time geography	370

World Cat	America and other	http://www.worldcat.org/

tidsgeografi	7
Zeitgeographie	3
time geography	332

21 dissertations & theses

British Library Integrated Catalogue	Britain	http://catalogue.bl.uk

tidsgeografi	1
time geography	16

Scandinavia:

Swe Pub	Sweden	http://swepub.kb.se/

tidsgeografi	8		
time geography	137	licentiate	16

bibliotek.dk	Denmark	http://bibliotek.dk/

tidsgeografi	3
tid geografi	3
time geography	105

Bibsys	Norway	http://www.bibsys.no/norsk/

tid geografi	203
time geography	142

Linda	Finland	http://linda.linneanet.fi

tidsgeografi	8
aika maantiede	70
time geography	132

Universitet individuell uppsökt

Götebogrs Universitet	2
Stockholms Universitet	54
Linköpings Universitet	0

Örebro Universitet	2
Uppsala Universitet	0
Luleå Universitet	0

9.3 Final Selection

Title	Language	Subject	Online availability	Found through
Dynamic Trip Modelling From Shopping Centres to the Internet	*English*	*Shopping centers, online shopping*	*no*	*KVK*
Mobilkommunikative Einzelhandelsräume	German	Internet shopping	no	KVK
Att lära, att göra, att klara	Swedish	information technology in pedagogy	yes	KVK
Informationssamhällets geograf	Swedish	information technology, work market	no	Bibsys
Meeting Places of Transformation	Swedish	local politics, urban life	yes	Linda
Human interactions in physical and virtual spaces	English	Cell phone Internet interaction	yes	WorldCat
Kreativitetens yttre villkor.	Swedish	Context influence on creativity	no	SwePub
Geovisualizing modeling physical and Internet activities	English	Internet usage	no	ProQuest
Online teacher professional development	English	Online teaching	no	ProQuest
Temporal GIS design an extended time-geographic framwork	English	Internet activity	no	ProQuest
The Role of Geography in Social Networks	English	Social networks	yes	ProQuest
Stormen Gudrun	Swedish	Disaster analysis / prepartness	yes	Lund University

first selection

alternative