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Why don't you express yourself so that I can understand!?

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Foreword

Before any reader starts absorbing themselves in this particular thesis, we wish to draw attention to its *narrative form*, since it is not the form usually associated with an academic thesis. Because of what we have learned during our working process, we have chosen to write it in a ***fragmented narrative*** form, where the text reveals itself to the reader in ways similar to that of an oral story. (The reasons for this will hopefully become clear when reading the chapters regarding Cognitive Science, and especially the part about the research at the Liverpool Museum).

A short description might be necessary, so that any reader, who may be perplexed with the breach of academic form, gets a brief explanation.

- The human race has had some sort of spoken language(s) for more than a million years, but the history of written language is only a few thousand years. (In a practical sense it is even much shorter than that).

Our brain has therefore adapted/evolved in a way that makes us grasp and comprehend a spoken story easier than a written one. One way of circumventing this "problem" is by trying to make the text "unfold" in a similar way to that of a spoken story. - Like spoken stories has unfolded themselves round the campfires over hundreds of thousands of years. That is; in a somehow fragmented way…

For anyone interested we strongly recommend the work by scientist Dave Snowden and Ron Donaldson, and their cognitive approach to *Knowledge Ecology* and "the complex nature of storytelling" - This is our interpretation of their approach, in a narrative form.

To put this in very simple terms; there are evolutionary explanations to why the human mind gets uninspired by a too structured text, or spoken story, for that matter. (Our chapter about Cognitive Science describes at least a part of the problem).

- If it is so that the theories about Cognitive Science which we investigate/describe are correct, what choice do we have, than to at least *try* to write our thesis in a way that suits the human cognition, as well as in a way that coincides with our theory chapter?

- "***Live what you learn***", so to say…

With this said; we wanted to investigate whether there might be some major flaws in how today's software was designed from the end-users standpoint. The reason to why we wanted to do this was that one of us had a background within software design and had often experienced a feeling, whilst working within this field, that that there was something "*wrong*" with how many programs were designed. Not that they were not working properly, because they mostly were, but that there was something odd in the way that the end user was expected to use them.

- The interface, or the way of how to use the programs, just didn´t feel *natural*...

The immediate question was of course if this was just his personal feeling, due to him being a computer geek, or if there was some truth to this notion.

We did, with the help of computer-wizard and friend, Ralf Carneborn, a "mass-interview" if one may call it that, which simply asked if anyone knew about, or had heard about that software, or hardware, had been designed with clear and stated consideration to how the human mind or psyche works.

Apart from the design of computer games the answer was, more or less; No, not really.

Due to the forum where this question was asked we have chosen not to deliberate further, since it was difficult to analyse the data in a scientific way, but the general meaning was nonetheless clear to us. (See *Appendix 1* for further information).

Not only do we believe that a simpler and more natural interface would benefit the end user, we also believe that it would be good business to do so. Imagine, for example, the financial benefits for a company if it can speed up the learning process of their new employees when learning how to use their particular software...

ABSTRACT

Title: Why don't you express yourself so that I can understand?

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Authors: Gunnar Ganzer, Anna Kaushnyan.

Key Words: Search systems, information seeking, information analysis, information discrepancy, communicative cognitive science, cognitive computer science, Knowledge Management

Purpose: Create an overall understanding of computers/software and cognitive science.
We also want to investigate discrepancies in 4 particular software systems (The discrepancies are between human/computer and NOT between the computer systems). We also want to investigate if eventual discrepancies, or successes, in the programs might have a connection to the human cognition. Meaning; are these systems built in a way that suits the evolutionary cognitive mind? (I.e.: how the human brain/mind works).
Finally, with the help of the four systems as practical examples, we wish to indicate the potential for further financial gain when designing software systems as a whole, using a cognitive approach.

Methodology: Due to the difficulty in extracting some of the confidential information, we had to write the thesis as an explorative adapted study, relying heavily on interviews, workshops and an explorative case study. The case being the Liverpool Museum project, researching children's answers of a museum filed trip. We also chose to make two surveys of our own. These will be either added as appendixes, and/or described in the text.

Theory: *Main*: Cognitive Science, focusing on the work by Dave Snowden.
Supporting/explaining; Computational complexity, Web scraping, Artificial Intelligence (A.I.), Black Swan and Knowledge Management.

Empirical foundation: Primary data consist of interviews, workshops and a survey of *LinkedIn.com* and *Monster.com*. Secondary data consists of scientific articles and information from the Internet and an investigation of two confidential search engines.

Findings and Conclusions: The investigation of the four search systems illustrates that there is a software design aspect linked to cognitive science. More research is necessary before any clear conclusions can be made, but this thesis implied that a least a part of the investigated discrepancy is caused by neglect of the human cognition when developing software. This also indicates that there is a potential for efficiency impact in financial terms, if considering this in future software development.

Investigative obstacles

There have been 3 main obstacles in the research for this thesis. They are as follows:

1. The research of the ***Echelon*** was made considerably more difficult by the fact that it is classified as a highly top secret project by all and everyone involved. It is therefore extremely difficult to find first hand data about the program, its functions and reliability. Most information is gathered from intelligence experts and various people involved in the different countries secret police (SÄPO, PET etc.). We have unfortunately not been able to obtain any written first hand information about the program or its reliability.

2. Same problem has presented itself when investigating the ***Chinese echelon***, even though it has been easier, since it is not considered to be classified per se, from a western point of view. Still, it has not been possible for us to call the Chinese embassy in Stockholm and ask for details…

3. It was unfortunately not possible to access all back ground data of the ***research project at the Liverpool museum***. Not that Mr. Snowden did not want to give them to us, but the project was to a large extent paid for by the private sector. Certain findings and patents were pending, which in turn made it "unpractical" to let any outsiders gain access to all data.

Author's thanks

We would like to thank Dave "*The Guru of Cognitive Science*", Snowden", for helping us out with material, meetings and information, even though he is a very busy man indeed.

We would also like thank all different interview objects, who had to suffer through seemingly endless interviews, full of naïve and sometimes dumb questions.

Last, but not least:

A resounding "**THANK YOU"** goes out to our mentor Leif Edvinsson, who truly is the "brain of the year"! Leif, who in spite of countless delays, remained a true source of optimism and enthusiasm. Leif, who used both evenings and weekends to help and support us. Without you Leif, we might have given up long before we were finished.

We hope that you all find this an interesting and thought provoking read.

Gunnar Ganzer & Anna Kaushnyan
Lund, 2009

Table of Content

1. Introduction

This chapter aims to describe who we are, why we have chosen the subject(s) we did and also present some practical examples hereof, followed by a discussion of the potential problems and the purpose. This to create a deeper understanding of the subject(s), as well as the problems within.

Keywords: Discrepancy, knowledge, holders, seekers

1.1. Our Pre understanding

We both have a multicultural background in the sense that we are not of Swedish origin and have both lived outside Sweden for large parts of our lives. This has made us aware of the differences in how different people/cultures understand the same phrases and pictures differently. We also both have a certain understanding and experience of working with computers. Gunnar Ganzer has developed and designed computer software for several years and, as stated in the foreword, he believes that there is something "wrong" with the way that most software is designed. Especially from the end user´s point of view. Many software systems just don´t seem to be "natural" when using them.

Gunnar Ganzer is presently working as senior officer in an EU project attempting to build an internet based school for children. (From first grade, so that young children living in remote areas should not have to go to boarding schools, or their families move altogether, for the sake of the children's elementary education). This project raises some very interesting issues. The most interesting in particular is; how does one build an Internet based school, for children with no, or very little, understanding of computers?
(There is, after all, no point in building such a platform, if the kids or their parents can´t find out of how to use it)...
This in turn has led to a close cooperation with the Danish board of Education and the Montessori approach to education and learning. The main thing with the Montessori school is

that it focuses on the minds natural learning processes. (How does the brain work, why and how can we benefit or adapt learning processes from this knowledge?).

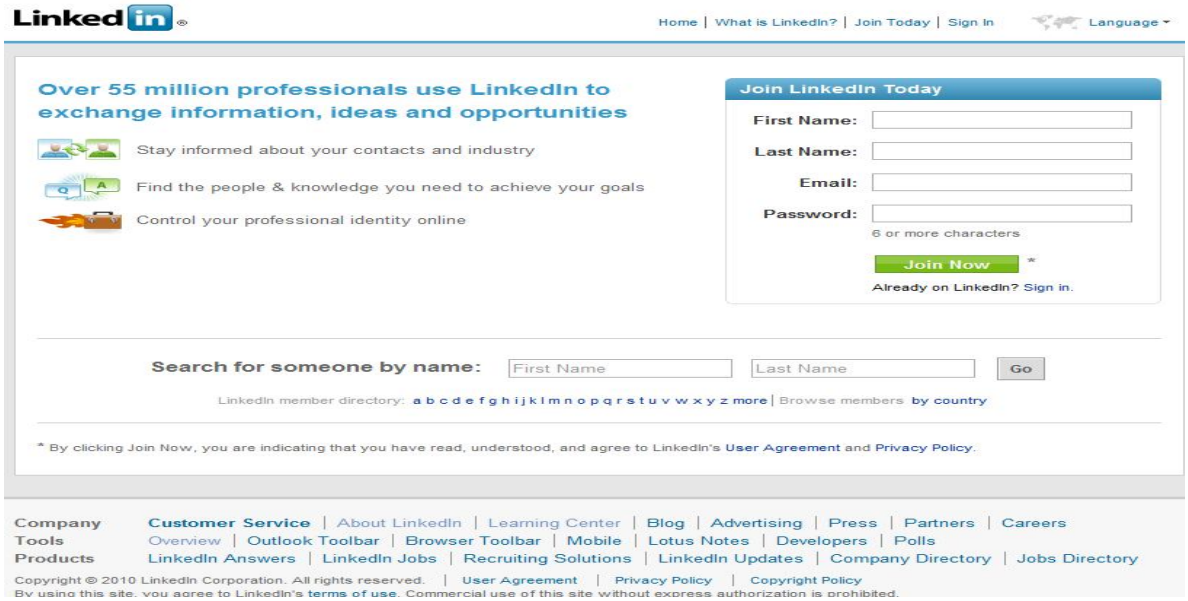
Anna Kaushnyan works with accounting, which has a system that was developed some 500 years ago, and where nothing much has happened since. Reminiscing our obligatory course in Accounting (Principbaserad Redovisning) as a part of the Master´s program, at least one of us remembers the accounting software, *Wisma Administration,* with true and sheer horror...

1.2. Background

May it be so that here is not enough consideration taken to what the human cognitive mind perceives as "*natural"* and easy to grasp? Let us give an example hereof:

- The interface of a software program can either have a lot of buttons/icons with text on them, or buttons/icons with pictures, or a mix between the both. Our belief is that a system with ***mostly pictures*** would be easier to use and faster to learn.

A small illustration of the above described[1]:



As seen above there is only three icons, or pictures so to speak, and considerably much more text... (LinkedIn will be thoroughly described later in this thesis).

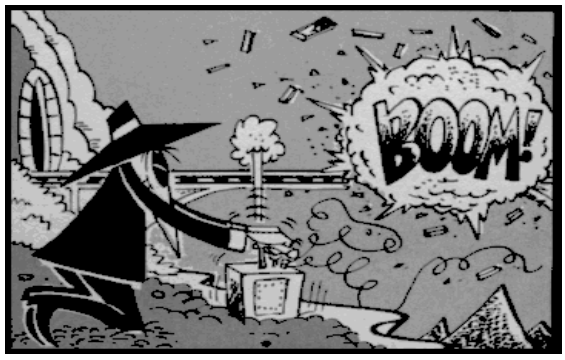
[1] www.linkedIn.com

The writers of this master thesis believe that there is always some discrepancy in the communication between those holding information (i.e.: knowledge) and those seeking it.
No matter if it is between individuals only (I.e.: Human capital), or between an individual and a computer (I.e.; Human capital – Structural Capital).
We believe that this might have a connection to how the software is designed?
We also believe that this causes a certain "loss" of impact of information, as well as inefficiency, in any given situation where information in being passed on between two, or more, intermediaries. This meaning that the information received might be the "wrong" one, or that the information received is not as optimal as it could have been, if this discrepancy in communication did not take place.

As described in the foreword we don´t know whether this need for user friendliness we have is caused by one of us being a "geek", or whether it actually is correct? (There is however research done that indicates that it is). During the 80´s the phenomenon of trying to create more "natural" programs was called ***Ergonomics***[2]. There is currently research done within cognitive science at the Museum of Liverpool. This research is, in our opinion, particularly interesting since it has a practical approach to the subject of cognitive science, discrepancy and software design. This will be described later, but first we need to explain the issue here.

Example A: Imagine a country that lives under a constant terror threat. The threat may be correct, or purely a work of the mind. The problem for this country mainly consists of two aspects:

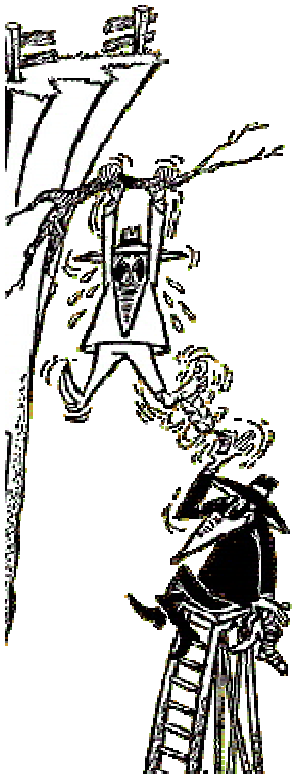
1. First of all the country's secret police needs to find out if the threat is real or not. If it is, a second problem immediately arises;
2. Where and when will the alleged act/acts of terrorism take place?



Now, let's call the terrorists the ***holders*** of knowledge/information, since they know where and when any terrorist attacks will take place. Let us also call the Secret Police of the country for the ***seekers*** of knowledge/information, since they do not know when the terrorist act will take place, but they would sure like to know…

[2] Leif Edvinsson, brain of the year, 1998

In this scenario there will most probably be a big discrepancy between the "holders" and "seekers", since it is fair to assume that the *holders* are somewhat reluctant to share their knowledge with the *seekers*. There will probably be no voluntary communication between the terrorist and the police, but there will be communication and passing of information between the terrorists (holders) themselves. This giving the police (seekers) the possibility to gain that information for themselves as well. The problem lies in the vast amount of information going around. Where are the *seekers* to look and how are they to know when, and if, they find the correct information? Finding the correct information is in this case a question of life or death.



Example B: A more daily scenario is the discrepancy between those looking for employment and those seeking someone to employ. The person looking for employment may render their information, in this case their CV, to a job database, where potential employers sift through the information (thousands and thousands of CV´s). This scenario has much in common with the above "Terror" scenario. Even though no lives may be at stake, the discrepancy is still there. The potential employee (holder of information/knowledge) might not express themselves in the same way as the potential employer, seeking someone suitable to employ. This causing that the seeker (employer) does not find the optimal employee. In this case the problem works both ways: the potential employee might not get a job at all, and the potential employer might not find someone to hire,
or might end up hiring a person who is not the best for the job in question. Thus; the potential employer will not find the optimal employee, simply due to the fact that there is a discrepancy in the way of giving and seeking information. Not as grave a problem as in the above terrorist scenario, but it may still be devastating for the single individual.

1.3. Problem discussion

The use of computers, in both business and personal life, has exploded the last 20 years. There are today thousands of software programs, used for such various purposes as searching for jobs/job candidates or calculating the neutron mass of an imploding star. There is also a great difference in how people perceive the differences between all these different programs and its user friendliness. Some programs may be perceived as easy to use and some as almost "impossible".

As described in the background there is obviously a discrepancy in knowledge seeking and holding, as well as the use of different software and the results we receive. We believe that there is a discrepancy between human – computer. The question is what causes this? There may be several reasons. Let us give a few examples for clarification:

1. Is this discrepancy caused by technical boundaries that cannot be altered? Is it so that the issue is strongly related to the hardware or programming, or is there no link, or just a weak one? There are after all hundreds of programming languages. (Java, C++, etc).

2. Is this discrepancy caused by great human differences between software programmers and software users? May it be the case that it is a certain "type" of people (I.e.: complete and utter nerds) that design software and that this "type" reflect in a way that is different to that of most of the end-users?

3. How much do we know about however software/computers are designed in a way that suits the human psyche/mind? We have after all developed over millions of years and computers have not been around for much longer than 50 years.

4. How much do we know about software design in comparison to how humans as a group would prefer to use it? Is there an adequate amount of research about this and if so, can we be sure that it is implemented in "real life"?

5. How big is said discrepancy? Is it substantial, or is it neglectable?

The list can be made much longer, depending on how deep one wishes to go into the subject, but as always we have to limit ourselves. With the above in mind we have therefore decided to address the following:

1. Try to create an overall understanding of computers/software as well as cognitive science. -- We believe this is necessary so that any reader who is not so initiated in these subjects will have a fair chance of "getting the message"...
2. Investigate the correlation between cognitive science, (the human mind) and the design and use of software, with a focus on discrepancy caused by eventual insufficient consideration to how the human mind gather information and learning.
3. How can an improvement in cognitive consideration when designing software improve savings and revenue? (I.e.: The economical aspect).

1.4. Objective

Apart from creating an overall understanding of computers/software and cognitive science, our objective is to investigate discrepancies in software systems (The discrepancies are between human/computer and NOT between the computer systems). We also want to investigate if eventual discrepancies, or successes, in the programs might have a connection to the human cognition, and illustrate this with a case from the Museum of Liverpool. Meaning; are these systems built in a way that suits the evolutionary cognitive mind? (I.e.: how the human brain/mind works). Finally we wish to show the potential for efficiency improvements and financial gain, when designing software systems with a cognitive approach.

1.5. Delimitation

We are well aware that the objective above is too vast for a Master Thesis. There are after all thousands of software systems. We will therefore limit ourselves to describing the issue with the example(s) of 4 specific search systems and supporting theories. This will be also done with an illustrative example at the Liverpool Museum, by Dave Snowden, within the field of cognitive science.

2. The ”how´s” – Method.

*This chapters aim to describe; **how** we have investigated our subject, **how** we collect and interpret our data, **how** we chose to present our thesis, **how** we interpret the scientific value of our collected data and, finally; our choice of practical examples.*

Presentation and information:

As described earlier we want to investigate the problem with discrepancy between software and the end users, but since it is such a large field we have to limit ourselves to doing so by presenting this in correlation with 4 practical examples. The question is now; **how** will we do this?

Since this thesis will be about such various subjects as computer technology and Cognitive Science, and their correlation in an economical perspective, we believe it important to give a thorough description of these subjects. There are two main reasons for this:

1. First of all our readers are mostly economists, who may have little understanding/knowledge about technology as a whole.

2. Our readers may also lack what we believe is the necessary knowledge about Cognitive Science.

It is therefore, in our opinion, essential to make certain that the necessary knowledge about these subjects are acquired during reading of this thesis. If not, we believe it will be difficult to achieve the scientific understanding of what we find, and why.

- Our information has been gathered from various sources; such as books and scientific articles, as well as 2 small surveys (made by ourselves), personal interviews and surfing the Internet. It is therefore of both qualitative and quantitative nature, as well as some of the gathered information is Subjective, whilst some of the gathered information is Objective.

- The scientific value of our sources varies. It comes more or less without saying to most readers that information gathered from a scientific article written by a Nobel Prize winner is higher than something collected from an unknown author on Wikipedia. (Not meaning that

the author on Wikipedia must be wrong; it is just that the possibilities for verification are not as strong). The reader will therefore have to take the information into consideration of what it is, and where it comes from. When gathering information from a small home-made survey, or by personal interviews, the data may just as well be subjective, as stated earlier.

We have chosen let this thesis unfold with a hermeneutic and fragmented narrative approach. There are mainly two reasons for this:

1. First of all it is hard, if not impossible, not to let our earlier described previous knowledge about computers, economy and software systems influence our subject and theory.

2. Secondly we have become more and more convinced during this thesis that an *unfolding* story is easier to grasp and understand, than a too structured rapport. (As explained in the Foreword). Hopefully the reader will get a deeper understanding for our reason(s) to do so, when reading our Theory chapter.

Practical examples and their selection:

We have chosen to use small practical examples and pictures as often as possible, to heighten the understanding of the text and hopefully also make the reading more amusing. We have chosen four systems in particular, which all perform a similar task, but where two of them differ significantly from the two other. This is mainly done to show that the issue of the problem (discrepancy) is wide and exist over the whole spectre of search systems. - We actually believe that it exists in all software systems, but we do not want to compare completely different systems with each other, due to that it may be difficult to explain the eventual differences. It might be like comparing apples with oranges...

With this said; it is at last time to present our 4 practical examples...

3. The 4 Search Systems

(The 4 main practical examples that will be used throughout the thesis)

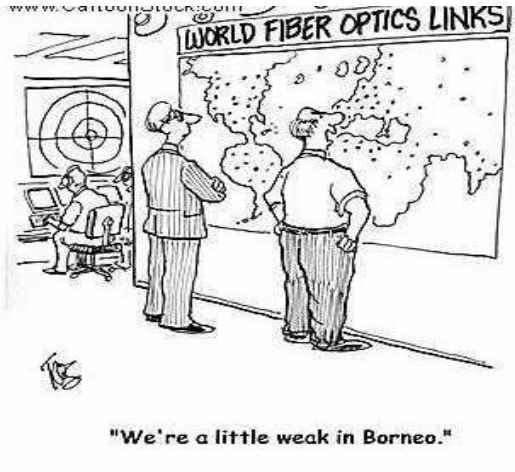
3.1. Echelon

Goal:
To survey and track all electronic passing of information, whether it be by e-mail, telephone, fax or otherwise.
(*http://en.wikipedia.org/wiki/Echelon)*

ECHELON is a non official name used in media and popular culture to describe a System Signals Intelligence (SIGINT). This system is run by, and collects/analyses information for its five signatory states; Australia, Canada, New Zealand, the United Kingdom and USA. (*http://en.wikipedia.org/wiki/Echelon_(signals_intelligence*)

ECHELON is supposedly capable of interception and content-inspection of all telephone calls (both land-line and mobile), fax, e-mail and other data traffic globally through the interception of different communication bearers. Such bearers are; satellite transmission, public switched telephone networks (which carries most Internet traffic) and microwave links[3].

Trying to "listen in" to others is nothing new and became widely spread during WWII and the following Cold War, when the use of short wave radio made it easier to send the needed military information, but at the same time also made it easier for others to "listen in". The rise of communications satellites in the 1960s presented new possibilities for intercepting international communications and "listening in"



[3] **Schmid, Gerard**, 2001 European Parliamentary (EP) report; "On the existence of a global system for the interception of private and commercial communications (ECHELON interception system), (2001/2098(INI))"

on others communication as well. The role of satellite data communications has today largely been replaced by fibreoptics. As of 2006, more than 90 percent of the world's long-distance voice and data traffic is carried over fibreoptics[4]. (The proportion of international communications accounted for by satellite links has naturally decreased accordingly). Thus the majority of communications cannot, as before, be intercepted by earth stations, but only by physically tapping cables and by intercepting line of sight microwave signals[5]. One approach today, when trying to "listen in", is to place intercept equipment at locations where fibre optic communications are switched[6]. For the Internet, much of the switching occurs at a relatively small number of places, called *"Hubs"*, where all information has to go through (be "*routed*"). This makes it relatively easy for anyone who wishes to "listen in" to do so. All they have to do is to place the needed equipment at these switches/hubs. In the past, much Internet traffic was routed through the U.S. and the UK. This is less true today, with, for example, 95 percent of all German Internet communications being routed via Frankfurt[4]. Thus for the *ECHELON* to work, either illegal intercept sites would be required, or the co-operation of local authorities. This since Germany is not a member of the *ECHELON*. (At least not officially...)[7].

- Even if *ECHELON* manages to place the necessary equipment at all the world's switches/hubs, the amount of information passing during any given time is certainly enormous. Reading and sorting out all of this information would be a task worthy of Sisyphus

From a technical standpoint it is therefore likely that *ECHELON* is more of a method of sorting captured signal traffic, than a fully comprehensive analysis tool. Much because of the fact that artificial intelligence is not yet developed enough to muster such a task as this[8].

[4] www.scb.se (Statistiska Centralbyrån).
[5] **Magnus Ranstorp**, Head of research at the "Centrum för asymmetriska hot- och terrorismstudier" (CATS), Försvarshögskolan, Stockholm, Sweden.
[6] **Gunnar Ganzer**; A "Switch" is a junction point where all, or most, traffic has to go through (be "routed"), before it is sent out over the world. (Much like gateways out of old cities, or the junction points of railroads)

[7] **Schmid, Gerard**, 2001 European Parliamentary (EP) report; "On the existence of a global system for the interception of private and commercial communications (ECHELON interception system), (2001/2098(INI))"
[8] **Magnus Ranstorp**, Head of research at the "Centrum för asymmetriska hot- och terrorismstudier" (CATS), Försvarshögskolan, Stockholm, Sweden.

Observation(s)

The phrase "*ECHELON is more of a method of sorting captured signal traffic, than a fully comprehensive analysis tool*" illuminates the technical and financial core of the problem.

- How is any Security Service ever to know where to look in this enormous traffic of information? And how is it to know/analyse if they have found the right information, or the most valid, if they ever find any significant information at all?

(As mentioned in; "*Background, Example A*").

Doing this would, due to the enormous amount of information, be very costly and require thousands of "sensors" working on all filtered information. It is also unsound politics to do so openly in most democracies. It is an entire ballgame altogether in a non-democracy….

3.2. The "Chinese Echelon"[9].

Goal:

To survey and track all electronic passing of information whether it be by e-mail, telephone, fax or otherwise.

Description:

- Chinas Population: 1 321 851 888 (2007)
- Internet users in China: 210,000,000 (2008)

The Chinese authority uses a sharp mix of propaganda, disinformation and repression to stifle online free expression and thus turning the Internet into its own propaganda media. China has also proven that the Internet can be totally controlled by any government that equips itself well enough to do so. China had in the start of 2004 more than 600.000 internet sites that had been approved by the authorities, a 60 % increase over 2002. Internet businesses were also booming. *Sina.com*, China's then biggest portal, announced turnover of more than 30 million Euros for the fourth quarter of 2003, a 197 % increase on the same period in 2002.

[9] All information in this section is from; www.rsf.org (Reporters Sans Frontières) and telephone interviews with **Benoit Wassans**, Reporters Sans Frontières (www.rsf.org)

To keep its foothold in this market, *Yahoo!*, amongst others, agreed to censor the Chinese version of its search engine and to control its discussion forums. So, if you enter "***Free Tibet***" into its search engine, you get no results. If you try to post a message on this subject in a discussion forum, it never appears online.

A powerful propaganda tool[10]

The Chinese government uses the Internet very efficiently as a propaganda tool and the Chinese state news media have an ever so powerful online presence. The authorised government news agency, *www.xinhuanet.com*, and the online version of *China Daily*, *www.chinadaily.com.cn*, receive literally millions of visitors each day, with a content that is entirely controlled by the Chinese Communist Party. Nonetheless, *complete control of electronic communication is yet not possible.*

Is free expression going down the drain?[11]

In 2004, the Chinese government banned sensitive issues from discussion forums on all major Chinese internet portals, such as *sohu.com* and *sina.com*. The direct result was that most political discussion forums were closed down and government controlled "moderators" (*ban zhu*) worked harder than ever to censor debates. Some time later, the government also blocked access to most blogs. - Blogs which previously had allowed tens of thousands of Chinese to publish their comments on current affairs.

At the same time Beijing also started closing down thousands of small, independent, cyber-cafés. Approximately 16.000 were closed during a short period in 2004. Since cybercafés are difficult to monitor, cyber-cafés would from now on only be run by a few large retail chains,

[10] All information in this section is from; www.rsf.org (Reporters Sans Frontières) and telephone interviews with **Benoit Wassans**, Reporters Sans Frontières (www.rsf.org)

[11] All information in this section is from; www.rsf.org (Reporters Sans Frontières) and telephone interviews with **Benoit Wassans**, Reporters Sans Frontières (www.rsf.org)

all controlled by the government. The cybercafés in question would all have to install standardized surveillance systems[9]. (Nowadays, it is not easy to discuss politics on the Internet in China…).

How does the censorship work?[12]

The structure of the Chinese Internet was from the beginning designed to **allow and simplify** control of information. There are only 5 *hubs*, through which all traffic must pass. It does not matter which Internet provider the user chooses; all their e-mails and information has to pass through one of them.

Several non Chinese companies also chose to cooperate with the Chinese authorities, when building the Internet in a way that allowed for control and "spying" on China´s citizens. It is a billion dollar industry, and the American company ***Cisco Systems*** has made millions in helping the Chinese government to build its surveillance infrastructure. Much equipment was even programmed with the help of Cisco engineers[8]. It enables the Chinese authorities to monitor and read almost all data transmitted on the Internet and to discover "subversive" key words. The police will then soon track down the dangerous "criminal" and pay him/her a visit...

Observation(s)

As the attentive reader notices it is a lot easier to control and monitor the flow of information in a non-democracy like China. China has, with its superior version of the American Echelon, effectively managed to suppress undesired information in a geographically vast country, with more than one billion people.

The technology and technique of "listening in" is the same in both Echelon and its Chinese equivalence; all information has to be routed through certain gateways/hubs. The fewer the gateways are, the more easily to monitor. Something China understood and built into their system.

The main problem is the same though; there is an enormous amount of information flowing in the systems. China has solved this with fewer gateways and tens of thousands of people seeking for eventual undesired information. No doubt they catch a lot, but there is no doubt

[12] All information in this section is from; www.rsf.org (Reporters Sans Frontières) and telephone interviews with **Benoit Wassans**, Reporters Sans Frontières (www.rsf.org)

that they also miss some of this "undesired" information. The problem being the same as with the "American *Echelon*"; where to look and how to know if you find the "right" information? And the task will become increasingly harder, the more people that start using the Internet.

3.3. LinkedIn.com

Description[13]**:**

LinkedIn is a virtual database for social and business networking. The idea is to have a website where people can keep in touch with old and new colleagues, get recommended by a co-worker and possibly find new employment. The site has become popular around the world and had by the start of 2010 more than 55 million members.

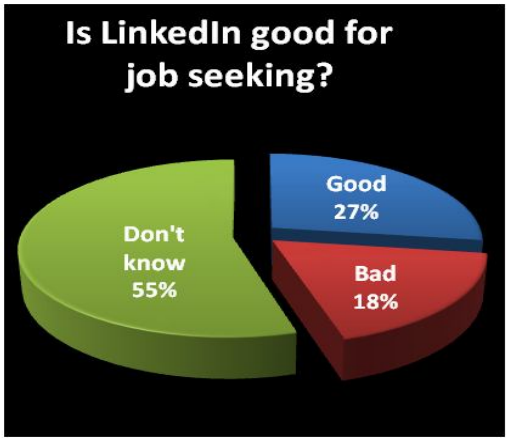
The idea with *LinkedIn* was to create a website where members could keep in contact with people they worked, or used to work, with. Much as "*Facebook*", only that *LinkedIn* focuses on professional relations instead of friends and family, such as Facebook does. *LinkedIn*'s users can add anyone to his or hers contact list, also known as "Connection". A search of these "Connections" can be made through the name of any University, company, person's name, or any second or third degree connection. *LinkedIn* gives the opportunity not only to stay in touch with people you know, but also to make some new acquaintances. (Just as Facebook). The website can also be used as a source of information for those who are looking for a job and as a human resource database for various companies and head-hunting agencies. The member/user may also be recommended by his/hers connections for a job, if the connections choose to do so. A little bit like "word of mouth", but over the Internet.

LinkedIn also offers a knowledge market service to its users; *LinkedIn Answers*. This service is similar to Naver Knowledge iN from Yahoo! Answers and other knowledge markets. The main difference between LinkedIn Answers and other knowledge markets is that on *LinkedIn Answers* one can ask mostly business related questions. In this way people with lots of experience and knowledge can help others with less experience, if willing to do so[14].

[13] www.linkedIn.com
[14] Anna Kaushnyan. (Medförfattare).

Users´ opinion

We did a small survey and asked members of LinkedIn about their opinion of the website[15]. They considered LinkedIn to be a good website, when keeping in touch with colleagues as well as when networking. On the other hand more than half of the people asked did not see LinkedIn as a job seeking website/database. Only 27 percent used it when looking for a job, but even they thought that the search function was somewhat misleading.



Head-hunters' opinion

In order to better understand whether *LinkedIn* is good for a candidate search we decided to ask several recruitment companies what they thought about this website. *LinkedIn* was considered by recruiters to be a good database for the search of "high profile" candidates. (For example; management consultants or executives with years of experience). However, when it comes to the actual search itself this website can be rather tricky. According to some recruiters one of the problems is that sometimes they cannot access the potential candidate's information since they are not in that candidate's network. Another problem is the complexity of the search tools. (Sometimes there simply are not enough keywords or questions in the selection tool).

Observation(s)

LinkedIn is apparently mostly used for keeping in touch with colleagues, but not for job seeking. It needs to improve its "*job*" and "*candidate*" search functions in order to attract more users and recruiters. (See *Appendix 2* for further information). Even though; there must be something appealing to the users, since LinkedIn has millions of members.

[15] See *Appendix 1* for more information

3.4. Monster.com

Description:

Monster.com is one of the 20 most visited employment websites/job databases in the world. The website is owned by the company ***Monster Worldwide*** and was created as a result of a merger of the two foremost and popular job databases on the Internet in 1999.[16] Over the years *Monster.com* has become one of the largest career websites in the world. During 2005 the website was visited by about 186 million job seekers. During 2008 about 16.4 million new resumes were published on Monster.com and approximately 14 million new accounts were created. At the same year almost 107 million job applications were sent through the website.[17]

As many other career websites the idea with *Monster.com* was to create a virtual place where job seekers, head-hunters and employers could meet. By filing an online résumé/CV the user automatically becomes a member of a world wide database. On *Monster.com* the user can not only file his/hers CV, but also choose in which countries he/she would like to work, what previous industry the user/member have worked in, (or is interested to work in), career goals, etc. When filing his/hers personal information the user/member can also choose whether to show all details to potential employers. Users/members can also choose the preference on how to be contacted and most importantly; what "***Search status***" the user has right now[18].
There are 3 different statuses on Monster; "***Searchable***", "***Confidential***" and "***Private***":

"Searchable" makes it possible for an interested employer to see all information in the potential candidate's profile.

"Confidential" gives an employer the opportunity to see all information of a candidate, except his/hers present employment.

"Private" hides the candidate's profile information from any potential employer/head-hunter and thus makes the profile unsearchable.

By choosing any of these statuses the user can avoid unnecessary calls or e-mails.

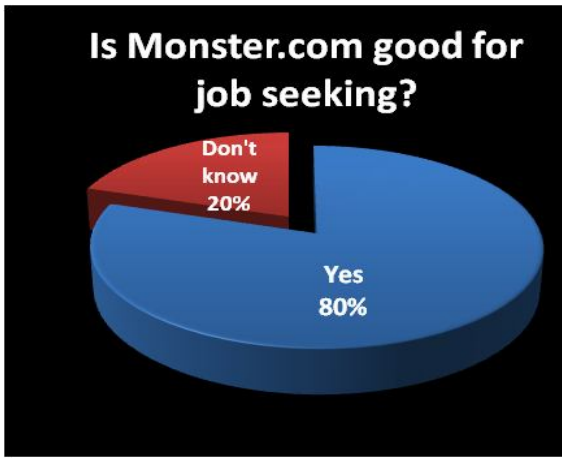
[16] http://www.careertrainer.com/Request.jsp?lView=ViewArticle&Article=OID%3A55989
[17] http://library.corporate-ir.net/library/13/131/131001/items/219758/factsheet_1106.pdf
[18] www.monster.se

A couple of years ago *Monster.com* launched a new free service called *"**Job Agent**"*. This service matches the user's profile with all available jobs and sends an e-mail to the user of any suitable jobs. E-mails with a job list can be sent daily, weekly or monthly. This gives the user the possibility to be updated about new job offers as often as he/she desires[19].

The difference between *Monster.com* and other career websites is not only its size and worldwide networking, but also the different services that it offers to its users. Here one can get help with practically everything a job seeker needs. Monster.com's users have access to various job seeking information and strategies: how to find the most suited job ads, which industries that are the most popular at the moment, how to network professionally, etc. Users are also guided in how to write a good résumé and given several examples hereof. "Monster" furthermore gives information about how to behave on job interviews, how to answer different questions and what questions to ask. Salaries, leaves of notice, information about conflicts at the work place and a lot of other useful information is also available[20].

User's opinion

Also here we did a small survey and asked people between 20 and 45 years old what they thought about Monster.com[21]. This website is considered to be rather popular among job seekers. According to Monster.com members the website contains a lot of useful information and is easy to use. Among asked people 80 % think that the search service is good or very good, 75 % either got a job/offer via Monster.com, or know someone who has.[22]



[19] www.monster.com
[20] http://karriarradgivning.monster.se
[21] See *Appendix 1* for more information
[22] All numbers and opinions are taken from the small study that we did – Gunnar Ganzer, Anna Kaushnyan.

Recruiter's opinion

Monster.com is one of the most used career websites among recruiters. More than 70 % of the recruiters that participated in this study used *Monster.com* for candidate searches. According to the recruiters *Monster.com* is easy to use, has good search tools and is almost perfect when it comes to candidate search abroad. Three out of four recruiters choose *Monster.com* as the first/best alternative for a candidate search.[23]

Observation(s)

Monster.com is one of the biggest and most popular career websites in the world and both users and recruiters are relatively satisfied with the services offered by the website. The major demand was/is that *Monster.com* improves its security to avoid information leakage. (Something that has already happened several times[24]).

3.5. Stage summary

The purpose of the four systems is the same; searching for information. Particularly: information about individuals. In the case of Echelon; individuals that pose a terrorist threat and in the case of LinkedIn and Monster; individuals who are potential employees. In the case of the two Echelons an improvement, or diminishing of discrepancy, could save both money and lives and in the case of LinkedIn and Monster it could save money.

We "chose" to make a survey for only LinkedIn and Monster, since it was not possible for us to make <u>any</u> survey about the use of the previously described Echelons. (For obvious reasons no one on the "inside" would answer any questionnaires about these two particular systems...). As from now the two Echelons´ part will be to describe/explain the complexity of the problem.

As the avid reader has now probably noticed we are convinced that there is a certain amount of discrepancy in all passing of information and knowledge. No matter whether it is the passing of non-consensual, top secret information as in the terrorist scenario, or whether it is in a more every day scenario as in *Monster.com* or *LinkedIn*. No matter what; the amount of discrepancy varies from scenario to scenario, but it is still there. The question is whether this

[23] Information is taken from recruiters' answers; Léonie von Hausen, European Recruitment Specialist. The Swedish recruitment companies wanted to remain anonymous.
[24] http://www.boston.com/business/articles/2007/08/22/data_thieves_hit_monstercom_site/

discrepancy is thoroughly researched and whether it is possible to diminish said discrepancy, as well as improve the user-friendliness/function with the help of Cognitive Science?

One may, in our case, ask oneself why this would be of interest to an economist?
The answer is simple; MONEY!...

- As briefly described in the Foreword; what if it would be possible to speed up the learning process of new employees, when learning how to use their new companies' particular software?
Not only would this shorten the new employees´ training time, but what if it even could be possible to heighten the efficiency of their use of these softwares after they´ve actually learned how to use them? Even the smallest of improvement in efficiency of the more commonly used programs (Such as SAP and Adobe, or in the case of the head-hunters; LinkedIn and Monster) would in accumulation render huge savings and efficiency gains.

4. Theory

This chapter describes the most relevant theories behind the thesis. Keep in mind that there are no theories that are "spot on" relevant to what we are trying to investigate.
Keywords: Black swan, web scraping, harvest, Artificial Intelligence, cognitive restrictions

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5.1 Intelligent Machinery[25]

Before we go any further in describing computers, web scraping, Artificial Intelligence (A.I.), or anything remotely connected to computers at all, it is important to describe the founder of today's computers and computing; **Alan Turing**.

Alan Mathison Turing was an English born mathematician and computer scientist. He was leading in the development of computer science and cryptology. Amongst other things he was the inventor of the machine which broke the codes for the German enciphering machine, *Enigma*, thus enabling the Allies of WWII to "listen in" to classified German military information. In 1936, **before** the first computers were invented, he also provided a formalization of the concept of the algorithm and computation, thus playing a significant role in the creation of the modern computer.

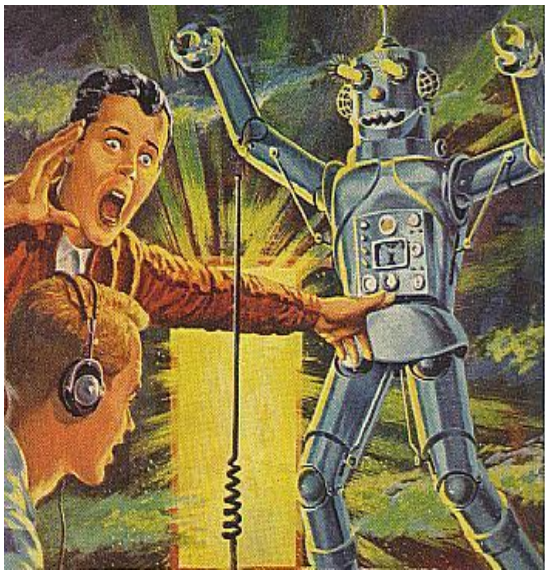
Turing researched the problem of Artificial Intelligence, and came up with an experiment now known as the "**Turing test"**; which works as a definition for when a machine is "intelligent". The idea is that a computer is able to "think" if it can fool a human into believing that he/she is conversing with a human instead of a machine. (The "conversation" is written and the computer is in another room, so that the human cannot see, or hear, whether he/she is communicating with a human, or a machine). Unfortunately Alan Turing's genious work was halted prematurely by the English government's persecution of homosexuals. He committed suicide in 1954.

[25] All information in this section is from; http://plato.stanford.edu/entries/turing-test/

5.2. Will there ever be Artificial Intelligence?[26]

Some 50 years ago computer programmer **Alan Turing** suggested that a digital computer, programmed with rules and facts, might be taught to exhibit intelligent behavior.
At roughly the same time ***Allen Newell***[27] and ***Herbert Simon*** proved that a computer could be used for much more than mere calculation. They proved that a computer string could stand for anything, even the real world, and that its programs could be used as rules to relate to these features. (This is now common knowledge and widely used within today´s computer science. All sorts of different computer programs are used for this today; such as flight simulation programs for students training to become pilots, etc).

- Remember that computers were at the time of ***Newell*** and ***Simon*** not digital, but "driven" by transistor tubes. What is now evident was then a groundbreaking achievement and the above gentlemen's discoveries were all in their own rights each and everyone *a black swan*…
The idea of A.I was in itself mind-boggling, but, alas, we are not very much closer to the goal of A.I. even today. Not that the scientists haven´t tried…



A large part of the problem with the last decades "stand-still" in the development of A.I. lies within what philosophers call "***a degenerating research program***".
The definition of this is a scientific enterprise that starts out with a great promise and offers new approaches, which in turn leads to impressive results *within a limited field or domain.* As long as it is successful scientists will inevitably try to apply the approach more broadly and apply it to similar problems. As long as it continues to be successful the research program

[26] All information in this section is based on the book; "What computers still can´t do - A critique of Artificial reason, by Hubert L Dreyfus.
[27] http://en.wikipedia.org/wiki/Allen_Newell: **Newell** was a researcher in computer science and cognitive psychology at the RAND corporation and at Carnegie Mellon University's School of Computer Science, Tepper School of Business, and Department of Psychology. He was awarded the ACM's *A.M. Turing Award* along with **Herbert Simon** in 1975 for their basic contributions to artificial intelligence and the psychology of human cognition.

expands and attracts more followers. The problem is that the moment it starts encountering different problems, that resists the new techniques, it will soon stagnate and quickly come to an almost complete halt.

Example: One of the truly brilliant leaders within the research of A.I., Professor Marvin Minsky[28], announced in 1967 that the problem of A.I. would soon be substantially solved, but then suddenly the project ran into problems. No doubt that the breakthroughs already made by members of his team, and others, were significant. But they were all made within similar domains. (Computers were solving problems in algebra, proving logical theorems, etc.). Professor Minsky and his team are today not very much closer to their promise of substantially solving the problems of A.I., than they were some 40 years ago…

- The problems started with the failure of attempts to program the understanding of ***children's stories***. One might say that the program basically lacked the basic common sense of a four-year-old…

Yet another culprit in the problems of developing a functional A.I. is the human linguistic problem. This based on the incoherence in how we, as a species, express ourselves in a sometimes grammatical incorrect way, but that we nonetheless still understand what the other person means.

Example:

Person 1: "Oh, man! I think I might gonna have to by our family a dog!

Person 2: Why?

Person 1: My 10-year old girl walked by a pet shop store´s window yesterday, saw a dog in ***it***, and now she wants ***it***!

We all understand that what the little girl wanted was the **dog**. It comes naturally to us, even though, that from a grammatical standpoint this is not clear. "***It***" may from a grammatical point instead represent the actual window, or even the pet shop.

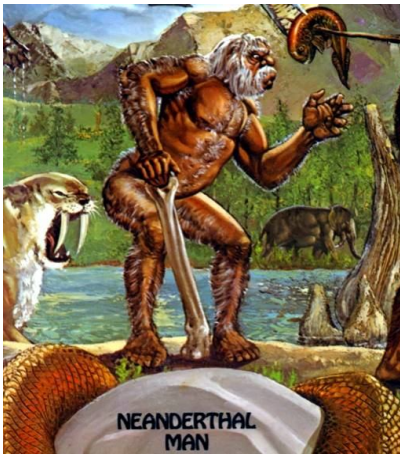
The problem is that this understanding does not come naturally to a computer…

[28] **www.wikipedia.org**; **Marvin Lee Minsky** is an American cognitive scientist in the field of artificial intelligence (AI) and co-founder of Massachusetts Institute of Technology's AI laboratory.

There has been extensive research done within the field of *Artificial Intelligence*, but the goal still seems to elude us. One must keep one thing in mind though; most discoveries which are now evident, were once a *black swan*, and what is now considered implausible may later on become yet another black swan…

5.3. How Homo became Sapiens[29]

(- and the human inherent cognitive restrictions).



Dr. Peter Gärdenfors has made some interesting research about the development of computing, the human brain, and our evolutionary cognitive boundaries. He concludes that while the development of computers and software is moving steadily forward, there are some genetically evolved boundaries in the human brain that should be considered when developing new computer programs.

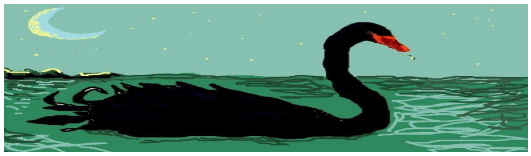
Computer science is now in a phase where humans soon will be able to literally speak to computers, and be spoken back to. We will not be able to have conversations, but to give and receive commands and instructions. This makes it even more important to develop future programs so that they fit the human evolutionary brain.

Prof. Gärdenfors states that even if humans have a free will and a plenum of different ways of thinking, we also have a way of thinking that is determined by biology and millions of years of evolution. This means that certain ways of thinking are in our genetic code and thus almost impossible to alter. If the development of computing does not take this into consideration, there will automatically be negative correlation between how computers/programs work and the biological patterns of thought in the human brain.

This also complies with Dr. Martin Ingvar[30], who bluntly states that today's computers and computer programs are designed in a way that does not correspond with the inherent human thought processes.

[29] All information in this section is from**; Peter Gärdenfors**, (Professor Cognitive Science, Lund University, member of "Kungliga Vetenskapsakademien"), "How we became Sapiens : On the Evolution of thinking" and " Den meningssökande människan".

5.4. The Black Swan theory



"An event or occurrence that deviates beyond what is normally expected of a situation and that would be extremely difficult to predict."[31]

The metaphorical expression "Black Swan" comes from the old assumption that "All swans are white". This was regarded as the truth until 1697, when the assumption was proven wrong by the Dutch explorer Willem de Vlamigh, who at that time was exploring the Western Australia and discovered the first black swans[32]. After this discovery the expression "Black Swan" eventually became a term for something that doesn't exist or could never happen[33].

The *Black Swan theory* was first described in Nassim Nicholas Taleb's book "The Black Swan" in 2007. The author compares in his book different historical events and scientific discoveries with "black swans". According to Taleb history gives several examples of scientific discoveries and historical events that could not have been predicted, such as computers, The Internet, WWI, etc. The "black swan" theory shows that things that we never imagined to ever exist or happen may become as common as the TV or the telephone in the future. (Which both, by the way, were *Black Swans* in their time). – The fact that you can't see it doesn't mean that it doesn't exist…

5.5. Web scraping[34]

Web scraping is a technique where different computer software collects information from websites. It also goes under the name of "*Web data extraction*" or "*Web harvesting*". The idea with this particular sort of software is to extract as much information from the web as possible, as fast as possible.

Web harvesting helps companies and private persons to rationalize their search for particular information.

[30] **Dr. Martin Ingvar**, (Professor i klinisk neurofysiologi, Professor integrativ medicin, Karolinska Sjukhuset, Sweden), (www.ki.se)
[31] http://**www.investopedia.com**/terms/b/blackswan.asp
[32] http://**en.wikipedia.org**/wiki/Black_swan_theory
[33] http://**en.wikipedia.org**/wiki/Black_Swan_emblems_and_popular_culture#European_myth_and_metaphor
[34] All information in this section is from; http://en.wikipedia.org/wiki/Web_scraping

Web scraping is mainly used in 2 areas:

1. ***When searching the Internet for various information***. - All search engines uses web scraping in one form or another. When someone types in a subject in the search field of, for example, Google, then Google "scrapes" the web for information within that particular field.

2. ***Within directed advertising on the Internet***. – Most, if not all, search engines uses this form of web scraping to tailor their ads and banners to better fit individual search patterns on the web.

Example[35]: Most of us have probably been a "victim" of commercial web scraping at least once, without even taking notice. Two good examples of companies making practical use of web scraping are the Google and ICQ search engines. The search pattern of each individual PC user is "*harvested*" by the search engines in question and the next time the user uses one of these search engines again, he/she will be able to see links related to his/hers previous search patterns.
In the case of Google and ICQ it is a more innocent form of "espionage", than ***Echelon*** or its Chinese equivalence, since Google and ICQ have only financial interest in knowing about their different user's preferences and search patterns. (Remember that both Echelon systems use web scraping to look for "subversive" words or phrases)...
A substantial part of Google's revenues comes from whoever is prepared to pay for being a "sponsored link" or having a banner. In the case of Google the web scraping simplifies and makes it possible to more effectively target the users with ads and commercials. It also helps making the ads/banners/commercials better suited to his/hers previous search patterns.
– The better the web scraping, the better and more efficient the ads and banners, which in turn, hopefully, creates higher revenue for Google.

5.6. Complex Adaptive Systems[36] (CAS)

Complex adaptive systems (CAS) contains *ordered* and *chaotic* systems and the relationship that exists between the systems and the agents which act within it.
In an ***ordered*** system the level of constraint means that all agent behaviour is limited to the

[35] **Ralf Carneborn**, Technical manager, Smartlaunch Ltd
[36] All information in this section is from; http://en.wikipedia.org/wiki/Complex_adaptive_system

rules of the system. (For example a computer program, since a computer program always has strict rules). In such a case there will be a clear and measurable correlation between cause and effect.

In a ***chaotic*** system the agents are somewhat unconstrained. For example a company's structure with both people and computer programs, working "side by side". In a CAS, the system and the agents therefore co-evolve; the system constrains agent behaviour to a certain level (i.e.; the worker´s/people´s behaviour), but the agents/people/workers modify the system by their interaction with it. This is similar in the way "Intelligent" computer programs work, in the way that it learns by previous "mistakes", and thus avoids making the same "mistake" over and over again.

As a result of this "double interaction" the system does not have an equilibrium state, but evolves constantly and is also disrupted even by small changes and tweaks. The correlation between cause and effect is not so clear and many times hard to measure. There is a known condition called "*Fundamental attribution error"*, which describes the tendency to give cause where no cause exists. This may very well be one of the main problems within a large part of today's Knowledge Management; trying to measure and calculate what may not be measured nor calculated.

5.7. Computational complexity theory[37]

A computer programmer may ask "As the amount of input to a computer program increase, by what factor does the computers running time and memory requirements increase? And what does this mean in computer and program speed?" In other words, complexity theory, among other things, investigates and defines the scalability of computational problems. In particular, it places practical limits on what computers can and cannot do.

A *problem* is the input of related questions/program lines, where each question/program line is a finite string, written in an algebra called "*Big O notation*", where the actual amount of resources uses numbers only to represent programming magnitude and not the exact resources

[37] All information in this section is from; http://en.wikipedia.org/wiki/Computational_complexity_theory

used by a particular machine, since different machines have different specifications and speed/strength.

The **time complexity**[38] of a problem is the number of steps that it takes to solve an instance (part) of the problem as a function of the size of the input, using the most efficient known algorithm. If an instance has length n and can be solved in n^2 steps we can say the problem has a time complexity of n^2.

The Big O Notation[39]: But of course, as mentioned above, the exact amount of resources will depend on what machine or programming language is being used. (Java, Basic, C++, etc). To avoid that difficulty, the *Big O notation* is generally used (the *O* stands for the "order/sequence" of the calculation). If a problem runs in $O(n^2)$ on one computer, then it will generally speaking also run in $O(n^2)$ on all others, even though it may take longer or shorter depending on how "up to date" the computer is. It is of importance to understand that "*O*" is in comparison with how powerful the computer in question is. Thus "*O*" allow us to generalize away from the system specifications of a particular computer.

For example, searching an unsorted list of words for a particular word will take, on average, half the time of the size of the list, because if one starts from the beginning one must (on average) inspect/read half the words in the list before finding it. (This assuming that one reads from the top of the "page" and downwards). If the word in question does not exist, one must inspect the whole list to discover that fact, so it could actually be worse; depending on how likely it is that a word in the input is in the list or not.

Binary search algorithms[40]*:* Speeds things up considerably; instead of reading through the list from top to bottom, it starts reading in roughly the right place from the start. For example; humans roughly know where to look in a phone book or dictionary, and use strategies to quickly get to their target; such as using headwords or a thumb index. This allows us quickly to get roughly to the right place, and then use a linear search ("top-to-bottom") when we are close to the target.

[38] http://en.wikipedia.org/wiki/Time_complexity
[39] http://en.wikipedia.org/wiki/Big_O_notation
[40] http://en.wikipedia.org/wiki/Binary_search_algorithm

5.8. Ignorance

Wikipedia.org defines "Ignorance" as; "*…the state in which one lacks knowledge, is unaware of something or chooses to subjectively ignore information.*"
Let us describe a case with subjectively chosen ignorance:

- The Space Shuttle Challenger disaster in 1986.

What happened was that the Challenger, a part of the NASA space program, exploded some 73 seconds into flight, due to an erosion based malfunction in the O-rings that were to seal the Challengers fuel tanks[41]. This is, from an engineering point of view, not so uncommon and as such not completely unexpected. At least not for an engineer, but for some reason it came as a complete shock for the management of the Challenger project.

"- Why is that so?" one may ask and the simple answer is; because of subjectively chosen ignorance. The management team deliberately chose to remain blissfully ignorant of the technical flaws that most engineers on the Challenger project warned them about.

Following extracts from the official Space Shuttle Challenger Accident Report[42], by **Richard Philip Feynman**[43], clearly describes the problem:

- "It appears that there are enormous differences of opinion as to the probability of a failure with loss of vehicle and of human life. The estimates range from roughly 1 in 100 to 1 in 100,000. The higher figures come from the working engineers, and the very low figures from management…..What is the cause of management's fantastic faith in the machinery?...Finally, if we are to replace standard numerical probability usage with engineering judgment, why do we find such an enormous disparity between the management estimate and the judgment of the engineers? It would appear that, for whatever purpose, be

[41] http://en.wikipedia.org/wiki/Space_Shuttle_Challenger_disaster
[42] "*Report of the PRESIDENTIAL COMMISSION on the Space Shuttle Challenger Accident*" (In compliance with executive order 12546 of February 3, 1986)
[43] http://nobelprize.org/nobel_prizes/physics/laureates/1965/feynman-bio.html: **Richard Phillips Feynman** (1918 – 1988). American physicist known for the *path integral formulation of quantum mechanics, the theory of quantum electrodynamics* and *the physics of the superfluidity of supercooled liquid helium*, as well as work in particle physics. For his contributions to the development of quantum electrodynamics, Feynman received the Nobel Prize in Physics in 1965.

it for internal or external consumption, **the management of NASA exaggerates the reliability of its product, to the point of fantasy**."…

- *"…* The phenomenon of accepting for flight, seals that had shown erosion and blow-by in previous flights, is very clear. The Challenger flight is an excellent example. There are several references to flights that had gone before. The acceptance and success of these flights is taken as evidence of safety. But erosion and blow-by are not what the design expected. They are warnings that something is wrong. The equipment is not operating as expected, and therefore there is a danger that it can operate with even wider deviations in this unexpected and not thoroughly understood way".

"The fact that this danger did not lead to a catastrophe before is no guarantee that it will not the next time, unless it is completely understood. When playing Russian roulette the fact that the first shot got off safely is little comfort for the next. The origin and consequences of the erosion and blow-by were not understood. They did not occur equally on all flights and all joints; sometimes more, and sometimes less. Why not sometime, when whatever conditions determined it was right, still more leading to catastrophe? In spite of these variations from case to case, **officials behaved as if they understood it**, giving apparently logical arguments to each other often depending on the "success" of previous flights".

"For example; in determining if flight 51-L was safe to fly in the face of ring erosion in flight 51-C, it was noted that the erosion depth was only one-third of the radius. It had been noted in an experiment cutting the ring that cutting it as deep as one radius was necessary before the ring failed. Instead of being very concerned that variations of poorly understood conditions might reasonably create deeper erosion this time, it was asserted, there was "a safety factor of three."

"This is a **strange** use of the engineer's term "safety factor." If a bridge is built to withstand a certain load without the beams permanently deforming, cracking, or breaking, it may be designed for the materials used to actually stand up under three times the load. This "safety factor" is to allow for uncertain excesses of load, or unknown extra loads, or weaknesses in the material that might have unexpected flaws, etc. If now the expected load comes on to the new bridge and a crack appears in a beam, this is a failure of the design. There was no safety factor at all; even though the bridge did not actually collapse because the crack went only one-third of the way through the beam.
The O-rings of the Solid Rocket Boosters were not designed to erode. Erosion was a clue that something was wrong. Erosion was not something from which safety can be inferred".
(- End of extract-)

Deliberate ignorance proved to be fatal in the Challenger case and lead to the death of all 7 of its crew members.

The management's deliberate ignorance in the Challenger case corresponds very well with the theories and description of *Knowledge and Management* by Professor Ursula Schneider. According to prof. Schneider there is mainly two ways to regard knowledge. Either as:

1. As humanity as a whole, where all humans have even access, or;
2. As a reigning elite, where knowledge is accessible only for the few.

No matter what, both visions regards knowledge as something given, solid and free of contradictions, and they are therefore both wrong, and the first view especially so. The main reason is that no matter which one of the above views that one is inclined to have; they both ignore the way that knowledge is socially constructed. Schneider states that since knowledge is socially constructed it will always be biased by different values and hidden interests[44]. - Just as the *knowledge* of the Challenger Management Team claimed that the risk of failure was only 1:100.000. This in turn also corresponds well with Professor Schneider's statement that *Power makes knowledge.* (Not the other way around, as stated by Francois Bacon).

When applying the lenses of social constructionism (within knowledge) and CAS thinking to the issue of knowledge in society, as well as organisations, we are confronted with a different story. Knowledge is constructed, subjective, full of contradictions depending on processing, context and different agendas and goals. A focus on knowledge alone ignores the other side of the distinction; which is ignorance and all its different reasons. This in turn, as shown in the above *Challenger* example, can lead to catastrophic results. This, according to Prof. Schneider, leads to the following propositions:

- **Ignorance is an exponential function of knowledge**.

[44] **Ursula Schneider**, (Head of Institute of International Management at the University of Graz). *"Das Management der Ignoranz"*, 2006

- **Different types of ignorance serve different functions**. (See; *Subjectively chosen ignorance*, above, or *Deliberate Ignorance*).

- **The most dangerous type is the ignorance of ignorance** (the blind spot).

- **The most viable type is the way humans filter signals in order to survive in a sea of signals and information overload.**

- This description is a key issue in the role of cognitive science and how we learn, but also why we learn so differently from one another. The cognitive parts of our brains work differently based on culture, agendas, language and background, amongst others.

5.9. Statistics and the Wisdom of Crowds

- *In 1906 Galton visited a livestock fair and stumbled upon an intriguing contest. An ox was on display, and the villagers were all invited to guess the animal's weight after it was slaughtered and dressed. Nearly 800 gave it a go and, not surprisingly, not one hit the exact mark: 1,198 pounds. Astonishingly, however, the mean of those 800 guesses came close — very close indeed. It was 1,197 pounds.*

(http://en.wikipedia.org/wiki/The_Wisdom_of_Crowds)

Sir Francis Galton discovered that the aggregated and accumulated wisdom of a crowd came to better and more correct conclusions than those made by experts within the field.
Hence; ***The Wisdom of Crowds***.

Galton also conceived the ***standard deviation*** and described the phenomenon of ***regression toward the mean***. Standard deviation is still used to measure the *statistical confidence interval*. The *margin of error* in a survey's data is at the same time determined by the expected *standard deviation* in the results, as if the same survey was to be conducted over and over again. (The reported margin of error is typically +/- 5 %)[45].

$$\sigma = \sqrt{\sum_{i=1}^{N} P(x_i)(x_i - \mu)^2}$$

James Surowiecki, amongst many others, also argues that the results from aggregation of information in groups are more accurate than those made by any single member or expert.

[45] **Svante Körner**, **Lars Wahlgren**, "*Statistisk Dataanalys*", 2000

This since a groups aggregated knowledge will always be wiser than its single members. No matter if its single members are experts within the relevant field, or not.
However, certain criteria have to be met, to make up a "wise" group[46]. (Bear in mind that a group may also be irrational, or even crazed…).

The necessary criteria according to James Surowiecki, are as follows:

1. **Diversity of Opinion**: Every member should have private information, even if this information is way off target, or just plain wrong.

2. **Independence**: Each member's opinions should not be determined by the other members.

3. **Decentralization**: (Also; *disorganized decisions*). Members should be able to specialize and benefit on local knowledge/information.

4. **Aggregation**: There must be some ways of turning each member's private judgement into a collective decision or mean/average (For example a good statistical program…).

Surowiecki classifies the advantages he sees in *disorganized decisions* into three types:

1. Cognition

The Market judgment; which he expects to be much faster, more reliable, and less influenced by political forces than the judgements/answers given by experts or expert committees. (Wisdom of Crowds all over again…)

2. Coordination

Common understanding within any culture allows remarkably accurate judgments/predictions about specific reactions of other members within the same culture.

[46] All information in this section is from**; James Surowiecki**, "The Wisdom of crowds; Why the many…", 2004

3. Cooperation

People tend to form networks of trust by themselves, without various central systems controlling their behaviour. (Example; Facebook, different Internet groups or chat rooms, etc.).

How is all of the above in this chapter then used in real life, as opposed to being "mere" theories? The most common applications today are:

1. Prediction markets[47]

A speculative (or betting market) created to make verifiable predictions. Prediction (information) markets ask questions like; "Who do you think will win the election?" and predicts the outcome fairly accurate. (Answers to the question, "Who will you vote for?" are not as accurate, since these types of questions are sometimes perceived as intrusive to the person being asked).

Betfair Ltd betfair

Betfair Ltd, working with predictions, is today the largest bet exchange in the world. (Around $28 billion traded in 2007). A betting exchange like Betfair allows gamblers to bet at odds set and requested by other gamblers, rather than by the traditional *bookmaker*. Not only has this eliminated the role, and cost, of the traditional bookmaker, but it has also made the odds much more accurate and fair. (If we may dare to use such a term when it comes to gambling…).

- Anyhow, this is an excellent example of how the ***Wisdoms of Crowds*** (the aggregated knowledge from millions of gamblers) proves to be much more accurate than the expert's. (All the bookmakers).
- Maybe this would work on the stock market as well, making all the overpaid "fat cats" and professional traders redundant?…

[47] All information in this section is from**; James Surowiecki**, "The Wisdom of crowds; Why the many…", 2004

2. Delphi methods[48]

"…A systematic, interactive forecasting method, which relies on a panel of independent experts". The practical implementation is that selected experts anonymously answer questionnaires in two or more rounds. After each round, a facilitator provides an anonymous summary of the experts' forecasts from the previous round, as well as the reasons they provided for their previous judgments.

This way the participants are encouraged to revise their earlier answers in light of the replies of the other members of the group. It is believed that this process will decrease the range of the answers and converge the group towards the "correct" answer. Many such consensus forecasts have proven to be more accurate than forecasts made by individuals. One may call it a combination of both *Wisdom of Crowds* and statistics. Only that instead of calculating a mean, the participants works together towards a common accepted answer.

- This being the equivalence of calculating a mean, to a question that cannot be calculated...

(Note the importance of independence and anonymity, to avoid biased answers. All equally important in James Surowiecki´s criteria of a "wise" group…).

5.10. Cognitive Science

This subject will be presented on its own in the following chapter, due to its importance to this thesis. We will try to give a thorough description of the field, which involves biology, neuroscience, evolution, gender, complex systems etc. It is a vast field, but important to understand for a better grasp of the following sections about the work of Dave Snowden.

[48] **James Surowiecki**, "The Wisdom of crowds; Why the many…", 2004

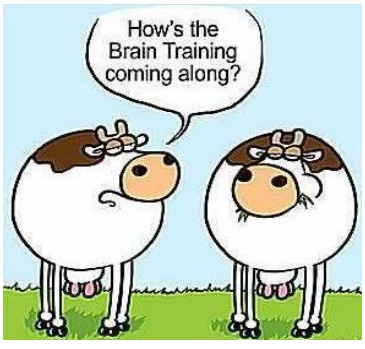
6. What is Cognitive Science?

This chapter aims at giving the necessary knowledge needed to better understand what Cognitive Science really is. It is a long one, but necessary for a better understanding of the upcoming chapter about Dave Snowden´s research project at the Liverpool Museum. It also gives a better understanding of the theories of previously mentioned Dr. Peter Gärdenfors, whose work is related to the work of Dave Snowden.

According to the ***Stanford encyclopaedia of Philosophy*** Cognitive Science is; "…*the interdisciplinary study of mind and intelligence, embracing philosophy, psychology, artificial intelligence, neuroscience, linguistics, and anthropology*".

6.1. History[49]

Even the ancient Greeks attempted to describe the human mind, when philosophers such as Aristotle and Plato tried to explain how the human knowledge and mind works. The study of the human mind lingered in the realm of philosophy until experimental psychology started to develop in the nineteenth century, when Wilhelm Wundt[50] initiated laboratory methods for a more systemic study of mental operations. Unfortunately the view of *behaviourism*[51] rapidly became dominant and little else happened within the field of Cognitive Science until the mid 1950´s. This all changed in 1956, when Princeton psychology professor George Miller summarized numerous studies that all showed that the capacity of human thinking is limited. Among many things, according to Miller, the human short-term memory is limited to around seven items.



Miller proposed that these memory limitations could be overcome by recoding information into "chunks" or images which, in turn, require mental procedures for encoding. At the same time computer pioneers such as Marvin Minsky, John McCarthy, Herbert Simon and Allen Newell were starting their research within the field of artificial intelligence. (Remember that in the mid 50´s computers had only been around for a few years).

[49] All information in this section is from; http://plato.stanford.edu/entries/cognitive-science/ (Part of the Library of Congress, USA).
[50] www.efpa.eu: one of the founding fathers of modern psychology, (dating from 1879).
[51] http://en.wikipedia.org/wiki/Behaviorism: ***Behaviourism*** *is a philosophy of psychology based on the proposition that all things which organisms do — including acting, thinking and feeling—can and should be regarded as behaviours. The school of psychology maintains that behaviours as such can be described scientifically without recourse either to internal physiological events or to hypothetical constructs such as the mind.*

6.2. Methods[52]

Cognitive Science is unified within its theoretical ideas, but there is a large diversity of methods used in the study of the human mind and intelligence. Even though cognitive psychologists today often engage in theorizing and various computational modelling, their primary method is experimentation with human participants. (As will be seen in the Liverpool project by Dave Snowden).

Example: Scientists have with experiments tried to investigate the kinds of mistakes often made by people in deductive reasoning, how humans form concepts, the fast people think with the help of mental pictures, as well as the performance of humans trying to solve different problems with the help analogies. Any scientifically significant conclusions about how the human mind works must be based on more than just "common sense", experiments are therefore vital... Experiments that approach the human mind and how it´s mental operations work in an array of different angels are therefore crucial. – The human mind works in individual ways and one cannot make a valid experiment within cognitive science without taking this into consideration.

Experiment without theory is blind: A major way of developing any theoretical framework is by creating and testing computer models in comparison to mental operations. As a complement to psychological experiments on how humans reason, form concepts, solves problems and uses mental images scientists and researchers have developed computer programs that tries to simulate how the human mind works. These programs are central within the science of ***A**rtificial **I**ntelligence*. (**A.I**.)

Neuroscientists, like cognitive psychologists, often perform such controlled experiments. The neuroscientists' observations are different in one main aspect though; the neuroscientists are mostly concerned with the brain´s biology, and not so much with it´s psychological processes. Using animal testing, scientists can directly and physically insert electrodes and thus directly record the biological patterns of the actual brain.

[52]All information in this section is from; http://plato.stanford.edu/entries/cognitive-science/ (Part of the Library of Congress, USA).

In recent years it has become possible to make similar experiments with human test subjects. Not by inserting electrodes, but by using magnetic scanning to actually measure and observe what is happening in different parts of the brain, as people are doing different tasks. Brain scans have now identified the regions of the brain used when forming mental images or processing language.

More evidence about how the brain functions is gathered by observing the performance of people with different brain damages.

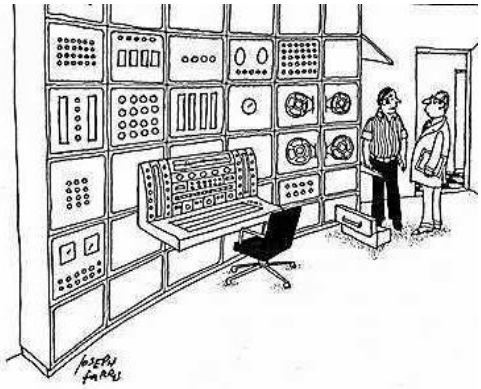
Example: A stroke in the part of the brain dedicated to language may cause the sufferer the inability to utter sentences, or even to speak at all. Another interesting example is the former stroke patient, ***Tommy McHugh***, who after a double sided stroke suddenly woke up with a remarkable talent for art and painting. McHugh worked as a construction worker and had a history of violence and substance abuse, prior to his ”fortunate” stroke. His only interest in drawing was in scrawling tattoos on his arms, whilst serving time in prison. Since his stroke in 2001, Tommy has felt a need to create, and has experimented with painting, drawing, writing and sculpting, dealing with themes relating to his 'split-mind', which Tommy states also has changed his personality.

(www.tommymchugh.com)

Cognitive anthropology expands the examination of how humans think into also considering how thought works within different cultural settings. This since the study of the human mind should not be limited to how only English speakers think. It shall also examine possible cultural differences in modes of thinking and within different languages as well. In its weakest form, *cognitive science* is no more than the sum of the fields already mentioned: Psychology, Artificial Intelligence (AI), Linguistics, Neuroscience, Anthropology, and

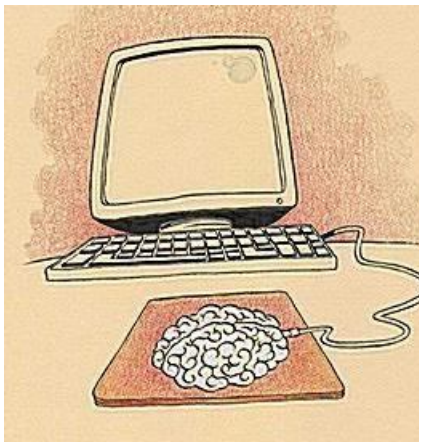
Philosophy. Interdisciplinary work becomes much more fascinating when there is convergence on the conclusions about the nature of the human mind.

Example: Psychology and AI can/is combined through computer models of people's behaviour in experiments. To better grasp the complexity of human thinking one has to use several different methods. This may be to use psychological and neurological experiments in combination with computer models. (This since different people behaves differently). Theoretically, the most successful approach so far has been to understand the mind in terms of ***representation*** and ***computation***.


"There's nothing physically wrong. It needs a psychiatrist."

6.3. Representation and Computation[53]

One converging hypothesis within cognitive science, as well as neuroscience and computer science, is that there are many similarities between a human brain and a computer. The one is made of flesh and blood and the other is made of electronics, but that is not the critical point. The critical point is how the computer and brain communicates within itself. How does our brain tell us to move a foot or to scratch our nose?
How does our brain execute our feelings?
How does the computer execute the different commands and orders in a program like Windows?
Above sciences all deducts that the human mind functions like a computer in the way that the signals sent within the brain are electrical and part of an analogue system. That is to say "on" and "off", or "Zeros" and "Ones" if you like. The brain also has computational structures similar to the computers algorithms.



[53] All information in this section is from; http://plato.stanford.edu/entries/cognitive-science/ (Part of the Library of Congress, USA).

Cognitive theorists reason that the mind contains mental structures such as rules and logic, images, concepts and analogies. The mind also uses these structures in combination with different mental procedures such as; deduction and searching for previously matching situations. (I.e.; has this, or something similar, happened before and how may this help me solve this particular problem?).

Cognitive Connectionists are researching the ideas about *representation and computation* that uses the brains analogue system as an inspiration for development of a new approach to computer structures. Thus they now work with an intricate three way analogy; the brain, the mind and computers. These can each be used to come up with new ideas about the others and how each part in the above analogy works. There is, as of today, no universal model of mind, or AI, but different programs have different approaches to how the human cognition may work.

Today's computers are mostly serial processors that perform one task at the time, unlike the human brain which is quite capable of performing multiple tasks at the same time. This is rapidly changing though; some recently developed computers are more like the human brain in the way that they are parallel processors, capable of doing many operations simultaneously.

6.4. The curious mind[54]

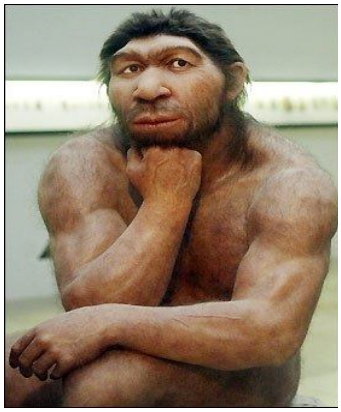
As described earlier Dr. Gärdenfors researches the cognitive limitations to the human brain. He describes how the human mind is "free", but at the same time restricted by inherent cognitive restrictions. One of many differences between our brain and a computer is our ability to parallel process information in a way that is not yet duplicated by the "computer brain". This may become duplicated in a not so distant future, though. The real difference is

[54] All information in this section is from**; Peter Gärdenfors**, (Professor Cognitive Science, Lund University, member of "Kungliga Vetenskapsakademien"), " Den meningssökande människan", 2006

the human need to "make sense", or find a meaning in most situations. Humans have tried to find a meaning in everything since we climbed down from the trees.

-What is the meaning of this?
-What is the meaning of that?
-What is the meaning of life?

One may also call this the human ***thoughtful mind***, which is one thing that distinguishes our mind from any other species on earth, as well as computers. Our minds **are** reflective and thoughtful, computers **are not**. The question is whether it will ever be possible to "teach" a computer to be thoughtful?...



6.5. Theoretical neuroscience[55]

"Theoretical neuroscience is the attempt to develop mathematical and computational theories and models of the structures and processes of the brains of humans and other animals". In recent years, computational models of the brain have become more and more accurate, though there is still a long way to go before they are any way near the human brain.

Today's programs simulate the brains neurons and the different pathways of the brain, as well as the connections between different parts of the brain. These programs are not meant as a substitute for the terms of Logic and Rules, but should mesh with them and show how the human brain functions at the neural level.

[55] All information in this section is from; http://plato.stanford.edu/entries/cognitive-science/ (Part of the Library of Congress, USA).

6.6. Memory, Understanding and Learning[56]

The brain constantly tries to give the individual the information needed as fast and correct as possible; thus maximizing the individuals chance for survival. From an evolutionary view this indicates that the brain is making adequate "guesses" about what´s going to happen.

The signals in the brain are only travelling at approximately 100 m/s, compared to a computer´s 300 000 km/s. To compensate for it´s slow speed the brain has developed the ability to parallel process information, which not only "computes" several data simultaneously, but also decides which data that is vital and needs to be considered first, and which that can wait until later.

To further enhance the efficiency the brain has ***automated*** several functions. Walking and talking at the same time, is one of them, but there are several others. (Walking and chewing gum, for example). This "automation" enhances brain function and saves brain capacity, but it does at the same time force the brain to work in certain pre-dispositional patterns. This means that the brain works in certain ways, evolved during millions of years.
The effect of this evolutionary and genetic pattern is that certain ways of learning and behaving works much better than others. If the evolutionarily decided pattern is disturbed, or forced to work in a non-natural way, the effects are almost always poor.
- Brain damage tends to have negative, not positive, effects on a person, for example. It does not stop at brain damage, which is more or less common sense. Certain combinations of colours, shapes etc, might also enhance our learning curve, while the "wrong" combinations will work against the human cognition.

The research of Dr. Martin Ingvar clearly indicates that computers are <u>not</u> constructed in a way that corresponds with the human cognition in a natural way. (Dr. Ingvar is so sure of this that he is not afraid to state this in public). If this being the case; could a more naturalistic construction not benefit our understanding and work with computers and software in the future?

[56] All information in this section is from; http://ki.se/ki/jsp/polopoly.jsp?d=2092&a=4382&l=sv; Article written and published when Dr. Martin Ingvar was inaugurated as Professor in Neurophysiology at Karolinska Institutet, Sweden, 1999.

6.7. Different Theoretical Approaches[57]

6.7.1. FORMAL LOGIC

A working tool for looking at the nature of representation and computation, and how we make logical conclusions. The explanation schema for the logical approach is:

Why?:

- Why do people make the conclusions that they do?

Because:

- People have mental patterns which are similar to sentences when drawing conclusions.
- People´s deductive procedures operate based on those sentences.
- Those deductive procedures, applied to the above sentences, give the conclusions.

- A word of warning; these are theories and even more efficient and psychologically natural methods of computation may be needed to explain human thinking.

6.7.2. RULES:

A great part of human behaviour is explained by the rules of consequence thinking. (**If** I do this, **then** this and that will probably happen…). Much thinking, such as planning, can be explained in such a system. The explanation schema used is:

Why?:

- Why do people behave in the way they do?

Because:

- People are aware of the rules of consequence.
- People have procedures for using these rules of consequence in the search for possible solutions, and at the same time procedures for generating new rules and understanding coming consequences, as they go along.
- Procedures for using, creating and understanding potential consequences decides the behaviour.

[57] All information in this section is from; http://plato.stanford.edu/entries/cognitive-science/ (Part of the Library of Congress, USA)

- Different computer programs/models based on these rules have provided fairly accurate simulations of a wide range of psychological experiments; varying from how the mind acquires new skills to language use. These rule based systems have also been of use and aid in the quest of developing *Artificial Intelligence.*

6.7.3. ANALOGIES[58]

Analogies, or ***resembling situations***, plays an important part in all areas of human thinking, such as problem solving, explanation, decision making and oral communication. Today scientists use computer programs to simulate how people retrieve and map analogies in order to apply them to particular situations. The explanation schema for analogies is:

Why?:

- Why do people have a particular kind of intelligent behaviour?

Because:

- People have both verbal and visual analogies of resembling situations.
- People have processes of retrieval, mapping, and adaptation that operate on those resembling situations.
- The analogical processes, applied to the representations of analogues, produce the behaviour.

- To most humans the constraints of similarity, structure, and purpose overcome the difficult problem of how previous experiences can be *found and used* to help with new problems. The other problem is whether any given problem/situation has an appropriate analogy at all. Not all thinking is analogical, and using inappropriate analogies can hinder thinking or make us come to the wrong conclusions.

6.7.4. IMAGES[59]

Pictures and other kinds of images all play an important role in the process of human thinking. A pictorial representation captures information much easier than lengthy verbal or written descriptions. (A picture says more than a thousand words…). There are today hundreds of different computer programs helping us create better visual

[58] All information in this section is from; http://plato.stanford.edu/entries/cognitive-science/ (Part of the Library of Congress, USA)
[59] All information in this section is from; http://plato.stanford.edu/entries/cognitive-science/ (Part of the Library of Congress, USA)

presentations and images. Programs such as *Microsoft Office Picture Manager* and *Adobe Picture Manager* are all invented because people are prepared to pay for something that helps them visualize potential presentations, situations etc.

Why?:

- Why do people have a particular kind of intelligent behaviour?

Because:

- People have visual images of situations.
- People have processes such as scanning and rotation that operate on those images.
- The processes for constructing and manipulating images produce the intelligent behaviour.

Imagery, or picturing, undoubtedly aids learning, and some argue that metaphorical aspects of language may even have their roots in imagery. Psychological experiments also suggest that the human minds visual procedures, such as "scanning" and "rotating", both use imagery. Recent research results within neurophysiology also confirm a close physical link between reasoning with mental imagery and perception.

6.8. Philosophy[60]

The interdisciplinary field of Cognitive Science is relevant to philosophy and the world of enterprise in several ways:

1. The psychological, computational, and other results of *Cognitive Science* investigations have important potential applications to traditional philosophical problems, such as ethics.

2. *Cognitive Science* can serve as an object of philosophical critique, particularly concerning the central assumption that thinking is representational and computational.

3. *Cognitive Science* can be taken as an object of investigation in the philosophy of the enterprise, generating reflections on the methodology and presuppositions of the enterprise in question

[60] All information in this section is from; http://plato.stanford.edu/entries/cognitive-science/ (Part of the Library of Congress, USA)

6.9. Philosophical questions[61]

Philosophical research today is often *naturalistic* in its nature. This meaning that it is treating philosophical reason in parallel with empirical work in fields such as psychology. - This will later be seen in the Liverpool Museum Research Project, by Dave Snowden. From a naturalistic perspective, philosophy of the mind is closely linked with theoretical and experimental work in *cognitive science*. Conclusions about the nature of mind are to be reached, not by *a priori* speculation, but by informed reflection on scientific developments in fields such as computer science and neuroscience. (That is to say that theory is to be formulated after the data is collected and scientifically analyzed, not before).

Below are a few relevant philosophical problems to further cognitive research:

1. **Heredity***;* Is knowledge inherent or acquired? (Is human behaviour primarily shaped by *nature* or *nurture*?)
2. **Mental imagery***;* Do human minds think visually and with other kinds of imagery, or only with language-like representations?
3. **Folk psychology***;* Does a person's everyday understanding of other people consist of having a theory of mind, or of merely being able to simulate them?
4. **Mind-brain identity**; Are mental states the same as brain states? What, if any, relation is there between psychology and neuroscience?
5. **Moral psychology***;* How do minds/brains make ethical judgments?
6. **Emotions***;* What are emotions, and what role do they play in thinking?
7. **Appearance and reality**. How do minds/brains form and evaluate representations of the external world?

6.10. Critique of Cognitive Science[62]

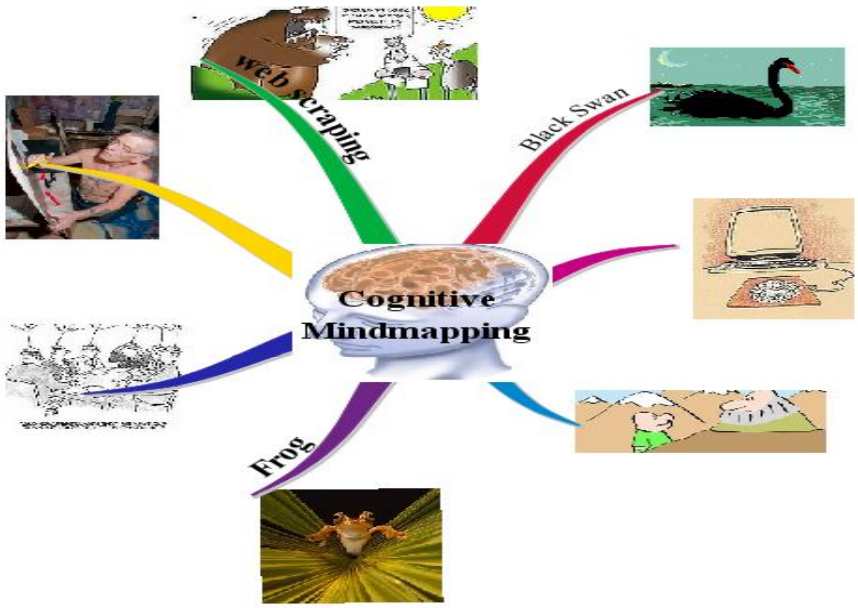
The assumption that the human mind human works by *representation and computation* is not a proven scientific fact, and might therefore be wrong. Even though this assumption has been successful in explaining many aspects of human learning, language use, problem solving etc, it still may not be accurate. There are still areas within the field of Cognitive Challenge with unanswered questions. Questions such as:

[61] All information in this section is from; http://plato.stanford.edu/entries/cognitive-science/ (Part of the Library of Congress, USA)
[62] All information in this section is from; http://plato.stanford.edu/entries/cognitive-science/ (Part of the Library of Congress, USA)

1. **Human emotions**: Some scientists say that Cognitive science neglects the vital role of emotions in human thinking.
2. **Human consciousness**: Does Cognitive Science ignore the importance of consciousness in human thinking?
3. **The physical world**: Is it so that Cognitive Science disregards the role of how physical environment affects how human thinks?
4. **Social inheritance**: Human thought and ideas are inherent in a social way that Cognitive Science ignores.
5. **The dynamic human mind**: The mind is a dynamic system, not a computational system.
6. **Mathematical issues**: Mathematical tests and results show that human thinking cannot be calculated or computed in the standard sense. The brain must therefore operate in a different way from a computer. Maybe as a quantum computer.

There is a great resemblance between the *Philosophical questions* in 6.9 and the *Critique* in 6.10. Some scientists argue that it is not so that Cognitive science disregards the critique made above (6.9); it is just that further studies are necessary.

6.11. Cognitive Mindmapping[63]



Modern mindmapping was "invented" by Tony Buzan, but mindmapping as a teaching technique has been used for centuries. It is based on the human cognition and the fact that

[63] All information in this section is from; http://en.wikipedia.org/wiki/Tony_Buzan

humans seem to learn and remember pictures better than mere words, due to our inherent genetic cognition. Words and pictures are often combined to enhance it´s effect. There is some discussion as to why it works, but Buzan claims that the mind gets "bored" by nothing but text, and that the human cognition finds it easier to relate a topic to a picture, instead of a massive amount of text. All in the spirit of the old proverb; "A picture says more than a thousand words". - May the fact that both *LinkedIn* and *Monster* have a interface design that relies heavily on both picture and colours, have something to do with their extensive number of users?

6.12. Economical aspect

Theory might very well be interesting, but, once again; what´s the point?
The point, from an economical point of view, is; how can we save, or make money, from the implication of cognitive science into the design of software design?

As stated in the Foreword*; "Not only do we believe that a simpler and more natural interface would benefit the end user, we also believe that it would be good business to do so. Imagine, for example, the financial benefits for a company if it can speed up the learning process of their new employees when learning how to use their particular software.."*

What if a cognitive improvement in the different software´s design could enhance their usability with just a few percent? This would in the case of LinkedIn and Monster potentially benefit both the head-hunters and the jobseekers financially. This goes not only for these particular programs, but for all programs.

As stated in 4.4. Stage Summary*: "Not only would this shorten the new employees´ training time, but what if it even could be possible to heighten the efficiency of their use of these softwares after they´ve actually learned how to use them? Even the smallest of improvement in efficiency of the more commonly used programs (Such as SAP and Adobe, or in the case of the head-hunters; LinkedIn and Monster) would in accumulation render huge savings and efficiency gains*".

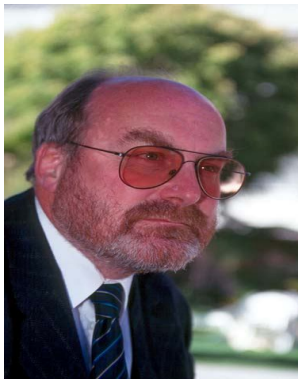
7. The Liverpool Museum research project[64].

*One of the foremost reasons to why we chose this case by Mr. Snowden is that it has a practical approach to cognitive science, when designing both programs and questionnaires used in his research project. (These will be described in the text). Other reasons were also that; that his results were **measurable**, even over a relatively short time span, (2-3 days). We were allowed to attain a 2-days course on this subject, held by Dave Snowden in Oslo, 20-21 October 2009.*

*The purpose of the Liverpool project and its following paper is to look at Knowledge Management from a **naturalistic perspective**[65]. It will be argued that current Knowledge Management practice is generally restricted by the wrong scientific models and a failure to reflect the natural evolutionary practices of humans and how the human mind works.*

Keywords: Knowledge Management, naturalizing, first fit, best fit, satisfying, optimizing, avoiding failure, chasing success.

7.1. A short presentation of the man behind the project[66]/[67]



Dave Snowden is one of the leading figures in the movement towards integration of a more humanistic approach to knowledge management, combined with appropriate technology and process design. He is well known for his work on the role of narrative and sensemaking, as well as a speaker on both academic and practitioner perspectives. Snowden has originally a degree in Philosophy and Physics from the University of Lancaster, but also an MBA from Middlesex.

Snowden has an extensive background from within the private sector as well. Amongst others he was formerly a Director in the IBM Institute for Knowledge Management and founder of the Cynefin Centre for organisational complexity. He pioneered the Cynefin framework as one of the first practical application of ***complexity theory*** to management science. He also pioneered the use of narrative as a means of knowledge disclosure and cross-cultural understanding.

- What does this really mean? –It basically means´ that Mr. Snowden was one of the first that tried to thoroughly investigate whether it really was possible and/or efficient to combine management mathematics and the mathematical laws of complexity theory with the field of knowledge management and people.

[64] All text in this chapter is based on the paper "Naturalising Knowledge Management, by Dave Snowden, 2009, several interviews with Dave Snowden, as well as previously mentioned work-shop in Oslo.
[65] **Naturalistic perspective**; that the project is measurable and that theory comes after observation. (7.5)
[66] www.gurteen.com/gurteen/gurteen.nsf/id/dave-snowden
[67] http://en.wikipedia.org/wiki/Dave_Snowden

7.2. Where, Why and Whom?

The research project took place at the Liverpool museum and the objective was to investigate how knowledge and experience was passed on between agents. In this case the ***visitors*** and the ***questionnaire***.

- The ***visitors*** in this case were schoolchildren in elementary school at different schools in Liverpool.
- The ***questionnaire*** was Mr. Snowden or associates.

There were several reasons to why schoolchildren in particular were chosen as agents. - Both practical and theoretical ones. The main practical was that when having schoolchildren as agents it is relatively easy to get answers/input. - This because one can make their answers as a school assignment, and thus get a greater rate in answers. (At least one can always hope that that would be the case…).
The theoretical is that the younger an agent is, the less personal bias would pollute his/hers answers.

7.3. How was it done? (A short description)

Meaning; how were the questions asked and how was the data gathered?
There are several problems to address when doing this type of research. In this case the most important ones were:

1. Should the questions be written or oral?
2. How does one prevent that the questionnaire "pollutes" the question with his/her own bias?
3. How does one prevent the children from giving the answers that they think the grown-ups want to hear, instead of saying/telling what they (the children) really think?

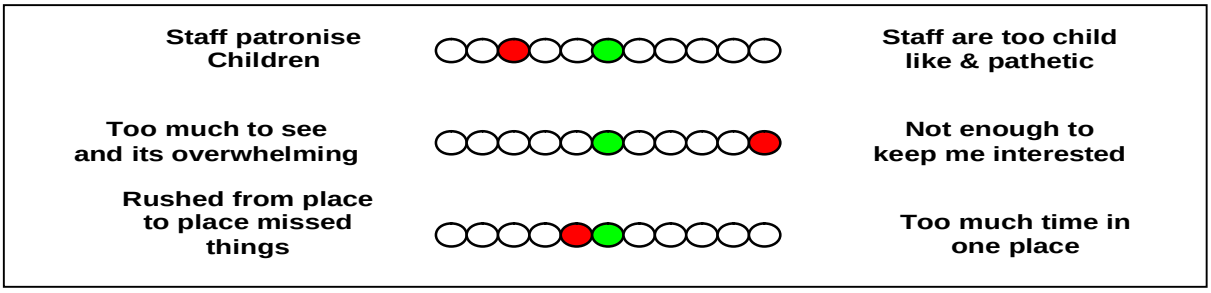
The first question was an easy one; since Mr. Snowden wanted to investigate how knowledge was passed on as a narrative, it had to be written questions and answers. Problem number two and three were trickier, since even written questions and answers can easily become biased.
– Just imagine the potential for bias if the questions were handed out during class and that all the children had to sign their answers with their name as well…

The problem was solved in a two-step solution: first off all a web-page was constructed, so the children could give their answers privately from a school computer or from home. Secondly they were allowed to answer in third person. The questions were constructed in this way:

- The questions should be about the whole of the experience/visit and should be designed to encourage elicit narrative material, rather than simple statements. (Such as "OK", "Good", "Bad", etc.).
- The questions should be asked in such a way that it stimulates the imagination of the subject, at the same time as the answer makes sense.
- The questions should not privilege positive or negative experiences from the Museum visit, but should seek both.
- The subject should be allowed to answer in third person (as mentioned above).

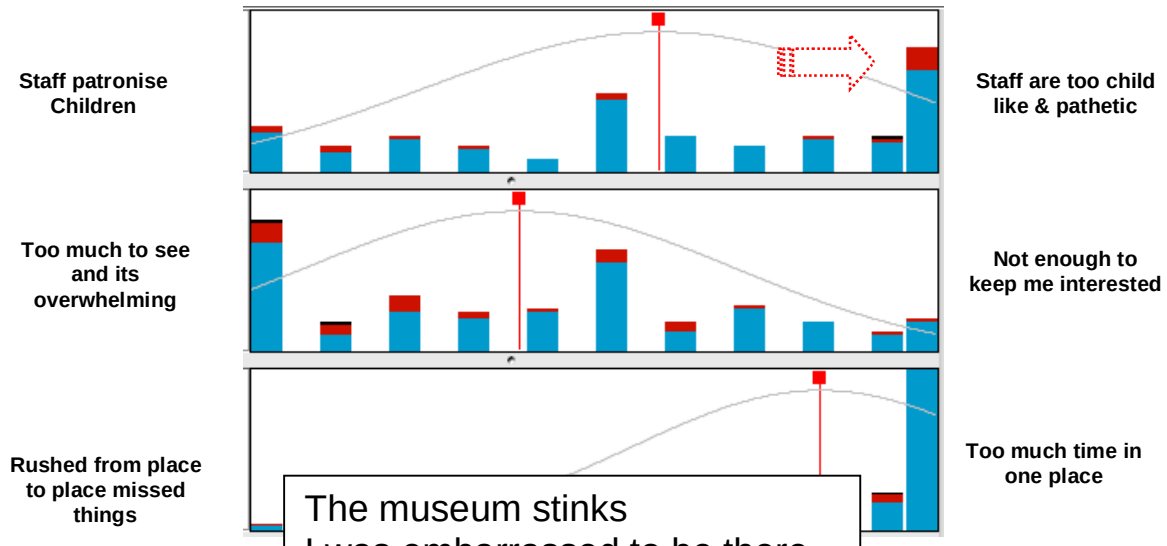
The children were asked some multiple choice questions and two "major" questions, which were designed to encourage a story. The one asked them to tell a story about their visit in a way that would enable them to persuade a friend to go to the museum, rather than play football. (Imagine that, in the town of Liverpool, of all towns!). The other asked them for a story about the visit to the museum that would persuade their parents not to take them to the museum, but instead allow them to play football with their friends. Such questions both ensure that you got the good and the bad experiences from the children's visit at the museum and at the same time made it hard for them to answer in simple statements. ("Ok", "Good", "Bad", etc.).

The genius of the survey was that the possible answers to the multiple choice questions were given as a choice between to negatives, as illustrated below.



Not only does this prevent the typical scale indexing, (for example as grades between 1 = bad, 5 = good), but it also makes it possible to accumulate more information in lesser questions.

One of the objectives of the survey/research was to find out whether the children liked their visit and what improvements that could possibly be made, based on the children's own answers. It was therefore of importance that the questions/answers would have as little bias as possible, as well as it was of importance to be able to measure the answers in "real time". This to be able to gradually make changes/improvements to the exhibitions and at the same time measure whether the changes had a future positive or negative effect on the children's rating/experience of their visit to the museum. Below is a chart of the children's answers, where the red part describes their recent answers and how these effects the charts statistics. (The intervals' may be on a daily, weekly or monthly basis, all depending on what the surveyor prefers). By indicating any area on the chart you can see the children's written contributions. The highlighted yellow text; "We never got to do anything" is the title of one of many answers. Below that is the actual text belonging to the title in question.



The museum stinks
I was embarrassed to be there
We never got to do anything

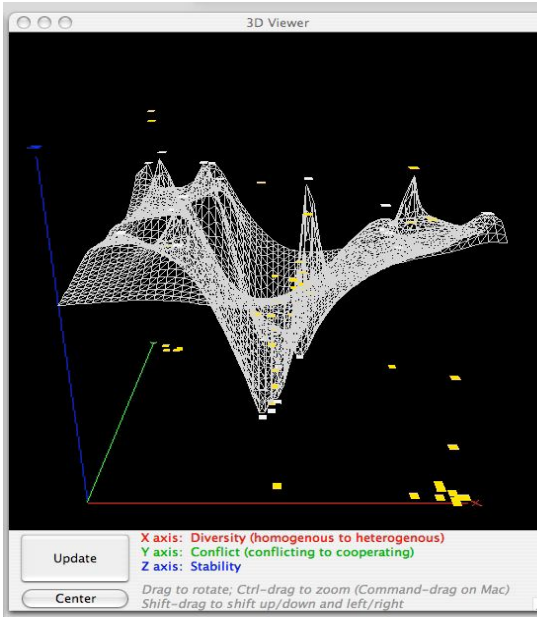
When were in the insect house I wanted to use the models. Mr Smith kept telling us about them but didn't let us touch them until the end and there wasn't any time. He can play with them anytime and I missed my chance because of him, its not fair.

7.4. The results.

The case results were that the answers received differentiated significantly from previous answers to the same questions, which were instead given in an environment which did not allow/encourage free thinking and story-telling as a part of the answer. (For example when an adult had been asking the children questions in person about if they liked the visit). This does probably not come as a great surprise to most readers, though.

The main effect was instead that it became possible, due to the design of the questions and the statistics program, to measure the results in "real-time". This enabled the museum to make continuous changes to its exhibitions, based on the children's answers. These changes were in turn also measured in "real-time", so that eventual positive/negative effects could be discovered and either enhanced or diminished.

To the right is a plot 3D chart that describes positive and negative feedback, in the form of "peaks" and "valleys".
The museum should try to diminish the valleys and enhance any peaks.
Without the children's "real-time" answers, this would not be possible, until after the exhibition. And even if it was, you wouldn't know the possible effects of eventual changes…



This basically means that the way the survey was constructed made it possible for the Liverpool Museum to make improvements during its course ***and at the same time*** discover whether the changes had the desired effect. This is fairly uncommon, since most surveys only deliver an answer after the survey is over. Meaning that if the exhibition was a failure, it would still be too late to do anything about it; until the opening of the next exhibition…

7.5. Knowledge Management[68] – *the Naturalizing approach*.

(Paper based on the findings/discoveries at the Liverpool Museum project, lead and written by Dave Snowden).

The Naturalistic approach:

The discussion of naturalistic approaches is complicated since "naturalism" itself has very little widespread or uniform understanding. A very brief explanation of the term is that the naturalistic approach consists of two main criteria:

1. Accommodating Science: Most of today's naturalists regard science to be an enormously successful enterprise. Thus all other knowledge claims must either cohere with the findings of our best science, or explain why it isn't so.

2. Empiricism: Knowledge comes from careful study of the world, not a priori theorizing.

As described in 7.3. above there is a great difference in how people interact and share stories/knowledge. (This due to differences in circumstances during the actual sharing). The Liverpool museum project showed that the children were much more innovative in their story-telling and knowledge sharing when they were allowed to work in an uncontrolled environment. (I.e.; not under adult supervision). Adults may behave in the same way, due to patterns in the human brain and how the human psyche works, no matter age. This implies that there is something wrong in today's ***Knowledge Management***, with its seeking for controlled environments. Let us first define *Knowledge management*. There are many definitions, all with similar context. The definition of Knowledge Management, according to Dave Snowden is:

1. To improve the way in which individuals and organisations make decisions by various means including, but not limited to, sharing knowledge from previous experiences.

2. Creating the conditions in which novel forms of knowledge can emerge, either in the context of immediate need or in research and development.

The purpose of the Liverpool museum project was too look at Knowledge Management from a naturalistic perspective and to look in depth at whether today's Knowledge Management

[68] All text in this chapter is based on the paper "Naturalising Knowledge Management, by Dave Snowden, 2009, several interviews with Dave Snowden, as well as previously mentioned work-shop in Oslo.

takes sufficient consideration to how humans interact with one another. (With children as the test group). This means that the research projects approach is to investigate whether it really is possible to manage knowledge and risk thinking based on probabilistic models which in turn are based on possible outcomes.

The approach is that humans make decisions in a way that might not work on a mathematically measurable scale and therefore it may not be possible to measure knowledge, knowledge flows or efficiency (within the knowledge field) in the today accepted way. This research project shows that the practice of deriving theory from "good" and "bad" examples in organisations may not be the best way to manage knowledge; but it is still the dominant method in management science and practice today.

Example: when being a student at Lunds Ekonomiska Högskola, we are constantly fed with examples of historically proven "right" and "wrong" decisions, within a multitude of different companies. Apart from the fact that it is always easy to be clever in hindsight, there is one major flaw in this way of passing and managing knowledge.

- The flaw is that what works for one organisation might not work for another.

The metaphor by Christensen & Raynor (2003) describes this in a beautifull manner;

Imagine going to your doctor because you are not feeling well. Before you've had a chance to describe your symptoms, the doctor writes out a prescription and says "take two of these three times a day, and call me in a week."

"But – I haven't told you what's wrong" you say. "How do I know this will help me?"

"Why wouldn't it", says the doctor. "It worked for the last two patients."

Surely no competent doctor would ever practice medicine like this, and no sane patient would accept it.

Yet professors and management consultants routinely prescribe such "of the shelf" solutions and managers accept it, in the naïve belief that what helped other companies to succeed ought to help theirs as well.

Not taking into consideration that most companies are what their employees make them; and employees are humans. And if there is one thing that all humans have alike it is the fact that we are not alike. Different humans have different ways of thinking, different ideas, different agendas etc. - Meaning that not two companies will ever be alike, as long as they have employees. There will of course be the occasional "bull's-eye" in the management consultant's advice, but considerably many more misses…

The above metaphor challenges the commonly used case based prescriptive approach using the benefits of hindsight and it challenges in particular one of the most used assumptions in *Knowledge Management*: that the meaning of *Knowledge Management* is to discover and establish ***best practice***. (i.e.: the best way of doing things). Since organisations and companies are what their employees make them, and all humans (employees) are different, it will be hard to establish a common best practice that works in every situation in every organisation...

A previous paper by Dave Snowden identified three "generations" of thinking and practice in Knowledge Management. Each "generation" shows that the more common computers and IT became in organisations and society, the more emphasis was put on making programs and charts of how to establish and introduce *best practice*, instead of actually finding out if this was practically possible.

Two general flaws in the above mentioned "generations", as within Knowledge Management as a whole, are:

1. The assumption that humans make decisions by evaluating all available information, and are motivated by personal self-interest.
2. The assumption of repeatable and discoverable relationships between cause and effect within systems, which allows the definition of ***best practice*** and the creation of repeatable "recipes" for organisations. (See previous doctor metaphor).

Both assumptions are wrong. The first assumption is wrong when stating that humans make decisions based on all information, and therefore optimizing their choice. Humans typically scan 5-10 % of all information and thereafter make a choice based on ***first fit***, not ***best fit***.
Thus the choice only has to be **satisfying**, not **optimizing**, as it instead would be if we scanned all information and then made our choice.
The choice made on the base of **first fit** and **satisfying** is a part of the human evolutionary pattern, as well as convenience.

Example; if one is to buy a computer, based on the assumption of optimizing, one would never get the time to buy a computer at all. This since there are so many brands and models. If one were to find out everything there was to know about them, it would be a never ending task. (Especially considering how fast the development of computers is…).

Most people are therefore content with the first computer that fit their needs to a satisfactory level, even if that may very well not be the optimal choice. Hence the ***first fit*** and ***satisfying***, instead of ***optimizing.***

One major argument in the work of Dave Snowden is also that avoidance of failure has had higher evolutionary value than imitation of success. In consequence the human race is more inclined to learn from ***worst practice***, than ***best practice***.

Example: if a child burns his fingers on a match he will learn much more about fire than through many a successful case about avoiding fire. - We learn from tolerated failure. (Though in the case of Calvin and Hobbes there may be no hope…).

The tendency that in most organisation stories about failure spreads faster than stories about success supports the theory that from an evolutionary aspect it has proven to be more efficient to avoid failure, than to chase success. (Less risk of dying when *avoiding failure* than when *chasing success*, no matter what form success might have had when the human race climbed out of the trees…). The cognitive part of the human brain might actually, through evolutionary processes, be programmed to look for possibilities of how not to fail, instead of looking for success. So not only are the human race a lazy breed that goes for the *first fit*, even though it may not be the optimal choice, but we are also by nature more prone to *avoiding* failure than *chasing* after success. It is all a part of the basis pattern of human intelligence and how the cognitive senses and decision-making of the human mind works.

A ”funny” observation is that there are a few people who are actually able to scan all (or most information) and make decisions without bias; they are autistic. In almost all, but very mild cases, this is considered a handicap…

What makes the human intelligence is not so much our capacity to scan and process information (5-10 %), but our possibilities *to discover and blend different information patterns*. This is turn is what gives the human mind its capacity for imagination and innovation.

By implication much of today’s *Knowledge Management* and *Management Science* has been operating of a false model of human decision making which, if followed through in a larger extent, would reduce innovation capacity. Future *Knowledge Management* should instead

focus on the management of above mentioned patterns. Stimulating relevant ones, disrupting already established patterns and at the same time thus creating the necessary conditions for innovation. - Create an environment that stimulates the cognitive parts of the human mind and at the same time awards new ways of thinking.

Simply put; if you want innovation and new ideas in an organisation, don't stay stuck in the same old rut. (Evolvement and development, as well as new ideas and innovation, is all about change).

7.5.1. Fail safe design vs. safe-fail experiments

If we understand that most environments are complex, then our expectations of decisions ought to automatically change drastically. Instead of expecting that everything is plannable and calculable in order and design, one ought to investigate how to make the potential environment as efficient as possible within the previously mentioned ***chaotic system***. One cannot adopt an approach based on ***fail-safe designs***, but should instead switch to ***safe-fail experiments.***

Example: Imagine a small engineering consultant agency. Said agency is frequently approached by various potential customers, who are looking for solutions for just as many various engineering problems. An environment like this, with a multitude of different problems and solutions to the same, will most likely be a so called *chaotic system.* This since it will be very hard, if not impossible, to establish strict management rules of how to work and solve all the different technical tasks and problems. Having a fail-safe design of how to solve the different engineering tasks will be more or less impossible. It will be hard to establish the, in management so longed after, ***best practice***.

One must give the agents (in this case the engineers) the possibilities *to discover and blend different information patterns.* (As mentioned on page 26).

What is needed is an environment with a focus on ***safe-fail experiments***, which allows and stimulates the cognitive parts of the human brain to respond to each individual situation and come up with innovative ideas.

- You never know what might come up…

What you do not want to do is to create a ruled environment for the engineers, with defined activities and milestone target achievements. That would "kill" the cognitive process and work against your goal; coming up with new ideas to all the various engineering problems.
What you want to do is to create an environment that encourages new thinking and new ideas. Many might not work, but those who do are the ones that you may develop even further.
This meaning that you establish general boundaries, but otherwise you leave it up to the agents (engineers). You **distribute** the power/decision-making to the agents (engineers) themselves after setting up the general boundaries, so to speak.

The idea of ***distributed cognition*** is central to the application of human cognition and its innovation/knowledge processes. It shifts the balance from central control to distributed control, where the focus is on increased interaction between the agents. (In this case the engineers).

A classical example of distributed cognition in real life finance is the **Grameen Bank**[69], which started lending funds to the poor of Bangladesh. The novelty was not the money-lending itself, but the way it was done. The bank lends money to self formed lending groups in which members of each village agrees to take on the same size load at the same time and also to guarantee each other's debts. This has produced debt repayment levels in excess of 97%, which are the highest in the banking world.

7.5.2. Fragmented narrative

One very interesting observation in the paper by Mr. Snowden is about the Internet. Even though the Internet is not organised in any way, by "*Knowledge Management standards*", its exchange and interaction in knowledge is still enormous. Even though, relative its size, there has been little investment in a so called *knowledge sharing culture*, people still do it. The knowledge sharing is in many aspects far higher than in any formal structure "approved" by knowledge management. A working hypothesis in the work of Mr. Snowden is that the fragmented social structure of the Internet far better reflects the evolutionary patterns of the human brain, than the abstract and centric focus of today's *Knowledge Management*.

[69] www.wikipedia.org: **Grameen Bank**. Founded by ***Muhammad Yunus***, Bangladeshi professor of economics who developed the concept of microcredit. In 2006, Yunus and the bank were awarded the Nobel Peace Prize.

Example: Who hasn't spent the better part of an evening, or a whole night, surfing the Internet looking for and reading about everything between heaven and earth. It may have been about such various subjects as bullfighting and knitting. The subjects themselves are not the issue here, but the fact that there often is a great variation in subjects is. If it is so that many persons surf the net for everything between heaven and earth, then that should tell us something about how the human mind works. And even more so about what spurs the cognitive and innovative parts of the human brain.

7.6. Snowden´s Cognitive conclusions

What were then the discovered implications by the Liverpool project? Some of them have already been given throughout the text, but not all. A more thorough description will be presented as follows:

- The fragmented nature of human recall and innovation needs to be reflected in the formal capture and distribution of knowledge. This means that since the way the human brain works is fragmented and often works in not so structured ways, it may not be beneficial to try to gather and/or distribute knowledge/data in a much too structured and static system. This since a far too structured system would not benefit the cognitive parts of the human brain and the way our thought/innovation processes work.

- A semi-structured system, which allows ***distributed cognition*** and ***safe-fail experiments,*** spurs the innovative processes of the human brain. (As opposed to the above). This much so because of our genetic inheritance.

- We learn more from **tolerated failure**, and the spreading of stories about failure, than we do from success. Once again this is caused by the human evolutionary process. It's in our genetic code to learn more from ***worst practice***, than ***best practice***.

- Forecasting outcomes in a complex system is not possible, as attempts of doing so will produce inauthentic results, strengthen entrained thinking and lead to false confidence. (This is beautifully described in the Challenger disaster example, with its discrepancy in risk of failure between the engineers and the management group of 1:100 to 1:100.000).

- The nature of *Knowledge Management* will wary according to the nature of the system. In an ***ordered system*** it may be possible to define ***best practice***. In a complex/***chaotic system*** it will be necessary to move from ***fail-safe design*** to ***safe-fail experiments***. This so that the evolutionary possibilities of a complex system may evolve and become visible.

- Switching to ***safe-fail experimental*** approach to an engagement/task, within a complex system, reduces risk over ***fail-safe design***.

7.7. Stage summary

Due to the amount of information, we find it necessary to summarize and enlighten eventual patterns. This for 2 reasons;

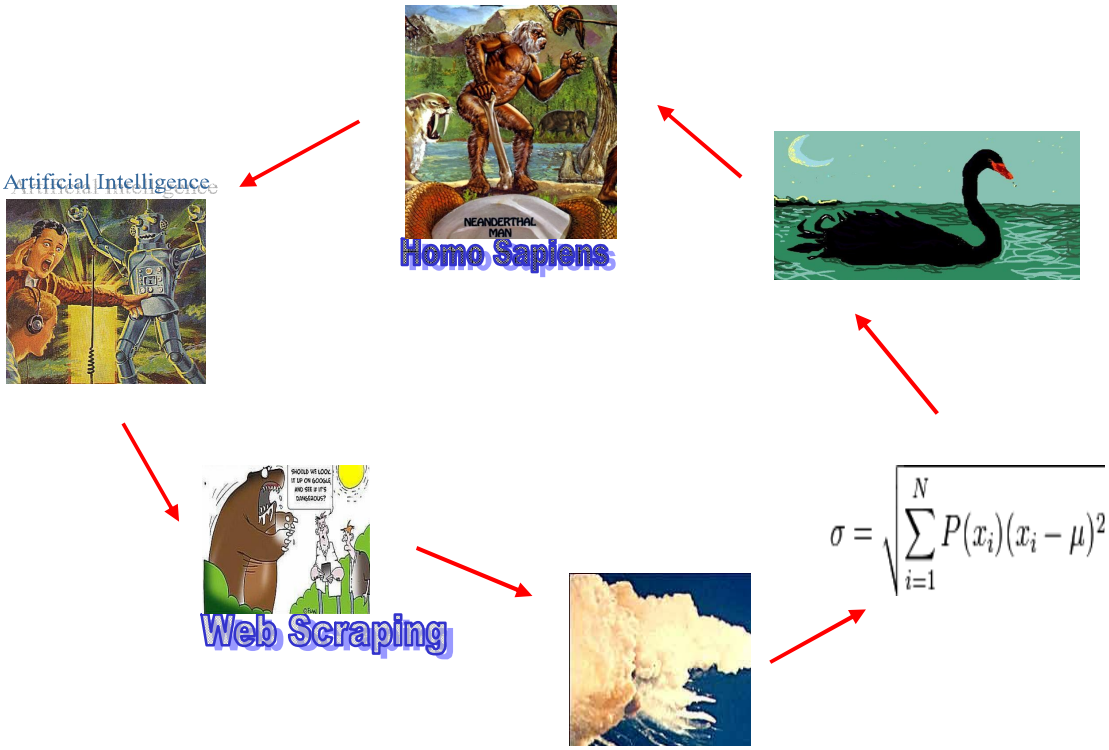
1. *To clarify the material until this point.*
2. *To enhance the understanding and acceptance of our following conclusion.*

This will be done "step-by-step", following the course of the text.

- **Objective**; our objective has been to investigate similarities and communicative discrepancies in 4 search systems, with focus on the human mind and cognitive science.

- **The four search systems**: "*the Echelons*", *Monster* and *LinkedIn* all show that there is a discrepancy in the passing and gathering of information. The systems differ between each other and their use as well, but there seem to be a common denominator; the tendency of lack in the systems´ sharing of information. - Even though users of both *Monster* and *LinkedIn* appears content with the systems workability.

- **Theory**: The sections about ***Intelligent Machinery***, ***Artificial Intelligence***, ***How Homo Became Sapiens***, the ***Black Swan*** and ***Web Scraping*** gives a base for understanding, when trying to understand software interface design and it´s underlying cognitive dimensions.



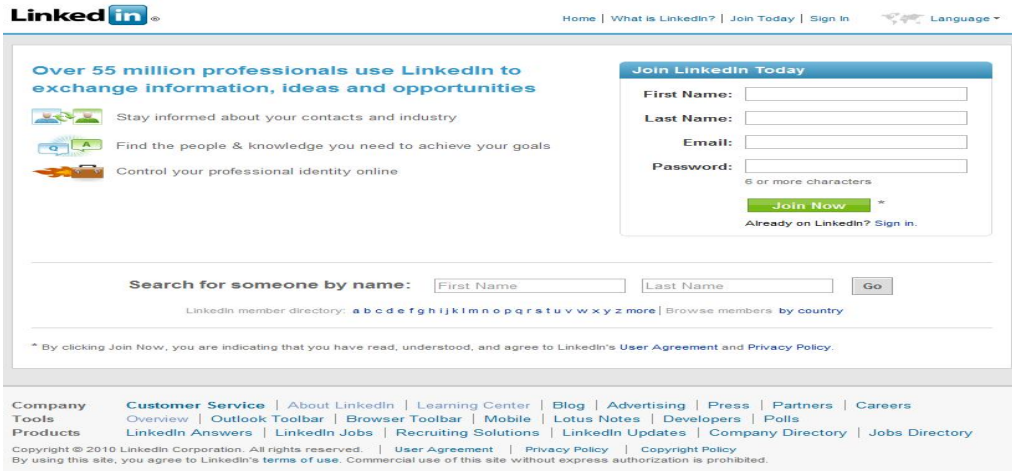
Cognitive Science: The human mind is basically unstructured. We understand, learn, work and gather information basically in a not so controlled environment. This might mean that a too structured system would works against the human evolution. Therefore also against our, over millions of years, evolved mind.

Liverpool Museum Project: A semi-structured system, with safe-fail experiments, as expressed by Dave Snowden, would therefore work better, since we learn more from tolerated failure. Humans live in a complex ecosystem, where it is not possible to always define *best practice*, but perhaps "*best option*" (This is on the other hand possible to do in the program code of the actual software, but not in it´s use).

Which, all of the above in unholy matrimony,
leads to easier learning and higher efficiency, which,
in turn, hopefully leads to more financial gain.

8. Conclusion

The four cases clearly illustrates that there is an interface and user aspect which is connected to Cognitive Science. There definitely seems to be a discrepancy. If it is so that the human mind works better with images, colours, as well as it works better in a not so controlled environment where it is allowed to experiment and experience tolerated failure, how come that there are still computer programs that looks like this?;



<u>instead</u> of this?;

Can it be that the difference between LinkedIn and Monster is due to how they are perceived by the human mind? Could this explain why only 27 % has gotten a job via LinkedIn, while 75 % have gotten one via Monster? (See Survey illustrations p. 22-25).

If this is so, it indicates that not enough consideration is given to the human mind when designing computer interface. As *Tony Buzan* so bluntly put it; the human mind gets bored by nothing but text.

- Still; even though it seems that *LinkedIn* may not be as big a success as the others, in certain user aspects, it still has 55 millions of members/users. (This is, all in all, a substantial amount of users, and it would be harsh to regard it as not being a success after all…).
People seem to have found other areas of use for the program, because the software design made that possible, at the same time as it was appealing to the human cognitive mind, or in other words; *Mind satisfying software design.*

It appears, in the case of *LinkedIn,* that the users were able to find other usage of a program than what might have been the original idea. This would not have been possible if the program´s design did not allow this. (It might very well not have been a deliberate decision while designing it, but the result was none the less the same).
- If it is so that the human works best in a *semi-structured environment,* with possibilities of trial and error and *safe-fail* design, how is it then that not every single program is designed in a way that makes it possible for the user to ***drag-and-drop*** the icons in the interface in any way he/she wishes?
This could create the, from Knowledge Management and Executives so longed for, *Controlled environment* and *Best practice*, as well as giving the user his/hers longed for mind satisfactory design. – User friendly in double dimensions!

Imagine if LinkedIn could get as good job searching results as Monster, or if the previously mentioned programs such as SAP or Adobe could become 10 % more efficient to use/learn?
The accumulated savings would be vast, when considering the amount of users of these programs alone. What if similar gains in efficiency and user-friendliness could be gained in all software?…

However, if any of this is possible remains to be seen. More research within the area of cognitive Science is needed, before more detailed answers can be given.
A joint research project between Cognitive Scientist and programmers/system designers could be really interesting. This brings us to what we believe may be **The** approach to future research.

9. Future research

We believe that his thesis shows that there is a considerable potential for efficiency and financial improvements in how to develop future software, with the help of cognitive science.

The human evolution has given the human mind some fixed parameters, (such as it has given all humans 2 legs and arms, one nose, one mouth etc, even though height and looks may vary).
With this is mind the approach to cognitive research in a software aspect should be in what people share on a cognitive level.

If done with a scientific approach it may give birth to a "how-to-do" list, when creating future software, based on what our human cognition has in common.

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- http://ki.se/ki/jsp/polopoly.jsp?d=2092&a=4382&l=sv
- http://en.wikipedia.org/wiki/Tony_Buzan
- www.gurteen.com/gurteen/gurteen.nsf/id/dave-snowden
- http://en.wikipedia.org/wiki/Dave_Snowden
- (The Internet in general)

10.4. Interview objects

- **Benoit Wassans**; Journalist, Reporters Sans Frontières, France
- **Dave Snowden**; Founder and Chief Scientific Officer, Cognitive Edge, Hong-Kong.
- **Gunnar Ganzer**; Drill engineer, Previous development- and World Sales Manager, Smartlaunch ApS, Sweden
- **Leif Edvinsson**; Mentor and Knowledge nomad, Stockholm, Tellus
- **Léonie von Hausen**; European Recruitment Specialist, Monster.com, Belgium
- **Magnus Ranstorp**; Head of research at the ”Centrum för asymmetriska hot- och terrorismstudier” (CATS), Försvarshögskolan, Stockholm, Sweden.
- **Marie - Laure Pommaud**; Senior Business Analyst, Monster.com, France
- **Ralf Carneborn**; “IT-guru”, Programmer and spokesperson for several American hacker-”communities” in Sweden. Technical chief for Smartlaunch ApS, Stockholm, Sweden
- **Ron Donaldson;** Knowledge Ecologist, English Nature, UK

10.5. Other

- Workshop in Cognitive Science, held by Dave Snowden and Ron Donaldson in Oslo, Norway, 20-21 October 2009.

10.6. Appendix

1. How, and why, the survey by Ralf Carneborn was conducted.
2. Survey by Anna Kaushnyan

Appendix 1. (Survey by Ralf Carneborn)

We wanted to find out whether there had been any significant consideration taken to the human cognitive mind when designing the first computers and software programs.
Since this was some 50 years ago most of the persons involved were not amongst us any longer. Even so, there were few, if any, willing to answer our questions. Most did not remember anyhow, since this was just after WWII and the beginning of the Cold War.
Priorities were different then, for several reasons.
This was a real problem, since **if** considerable consideration actually **had been taken**; it would make our thesis somewhat **redundant**. We needed to find out, or at least get a fair indication, of the lay of the land.

After giving this problem some thought we discussed it with our friend Ralf Carneborn, who is held in high esteem within several online communities. (He is amongst other things member, and spokesperson, for several hacker communities in the Nordic region).
Ralf agreed that he would "*ask around on the net*", as he put it, and get back to us.

After 4-5 days we got a call from Ralf, who told us that, as far as he could find out, there had been little consideration taken to our subject, when designing the first computers/software. He had let the word out on the different communities and very few people had had any positive input on the subject, apart from when designing computer games.

-- To clarify why we put such trust in Ralf it is important to clarify how these communities work. The more "cred" a member holds, the higher the cooperation and willingness to help from other members. Since Ralf is held in high esteem, and by some regarded as an "internet hero", the willingness to help is high. This might not be a very scientific way to conduct a survey, but it does give a fair indication of the subject. --

Appendix 2 (Survey by Anna Kaushnyan; *LinkedIn* and *Monster*).

(Questions were given to 50 persons, of whom 15 were headhunters)

Questions about LinkedIn (users)

1) How long have you been a LinkedIn member?
2) What do you think about the website?
3) Have you gotten a job, or job offer, with the help of LinkedIn?
4) Do you know anybody who got a job/ job offer via LinkedIn?
5) How good is LinkedIn for job searching?

Questions about LinkedIn (headhunters)

1) How long have you been a LinkedIn member?
2) What do you think about the website?
3) Do you use LinkedIn for candidate searches?
4) How good is LinkedIn for candidate searching?
5) Have you found any suitable candidates with the help of LinkedIn?
6) How many of the candidates found via LinkedIn were offered the job, which you thought they were suitable for?
7) What should be done in order to improve the website?
8) What other websites do you use for candidate searches?
9) In your opinion, which of the websites for candidate searches is the best?
10) What, in general, you would like to improve on the job/candidate searches websites?

Questions about Monster.com (users)

1) How long have you been using Monster.com?
2) What do you think about this website?
3) Have you got a job, or a job offer, through Monster?
4) Do you know anybody who got a job/job offer via Monster?
5) How good is this website for job/candidate searches?
6) What other websites for job/candidate search do you use?

Questions about Monster.com (headhunters)

1) How long have you been a Monster.com member?
2) What do you think about the website?
3) Do you use Monster.com for candidate searching?
4) How good is Monster.com for candidate searches?
5) Have you found any suitable candidate with the help of Monster.com?
6) How many candidates that you found on Monster.com, were offered the job you thought they were suitable for?
7) What do should be done in order to improve the website?
8) What other websites do you use for candidate searches?
9) In your opinion, which of the websites for candidate search is the best?
10) What in general you would like to improve on the job/candidate search websites?

Our learning journey

1 Two roads diverged in a yellow wood,
And sorry I could not travel both
And be one traveller, long I stood
And looked down one as far as I could
To where it bent in the undergrowth;

2 Then took the other, as just as fair,
And having perhaps the better claim,
Because it was grassy and wanted wear;
Though as for that the passing there
Had worn them really about the same,

3 And both that morning equally lay
In leaves no step had trodden black.
Oh, I kept the first for another day!
Yet knowing how way leads on to way,
I doubted if I should ever come back.

4 I shall be telling this with a sigh
Somewhere ages and ages hence:
Two roads diverged in a wood, and I -
I took the one less travelled by,
And that has made all the difference.

- Robert Frost, "The Road Not Taken"

"*It might be easier to take the road more travelled, but it's much less interesting.*" – G.G.

The true contributors in any field are few and often as busy as they are scarce. When combining above problem/issue with the investigation of a couple of computer programs that are classified for security reasons it will, from time to time, be a nuisance to find relevant and trustworthy information.

Looking in depth at a subject like the human psyche/mind is not an easy task in itself. When doing this in combination with how the human mind affects how we make use of computers, the Internet, different *Search Engines* and various other computer programs it becomes even more complex…
- Having an enthusiastic mentor with a solid network is of the essence.

There is much more research needed within the field of Cognitive Science before any clear answers can be given about how the inherent biological factors of the human mind affects our daily life and use of computers. What we do now is that these factors ***do*** affect us. We are just not sure how, and how much. When more research is conducted we may be able to develop computer software that is better suited to the human psyche and how our minds work. In the case of this particular thesis it might, for example, help future programmers to develop better and more user friendly search engines.

- To be continued…