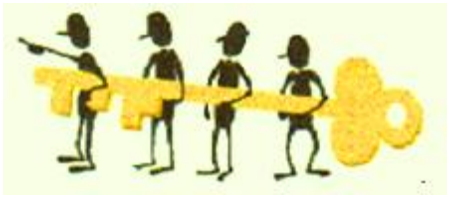

HO of IT: Historical backgrounds

History of HO (Human Orientation) of IT (2014)

Vienna, March 2014

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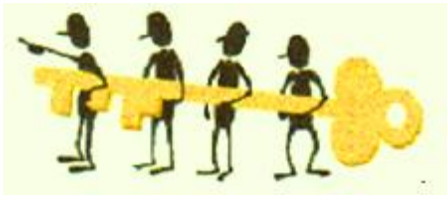
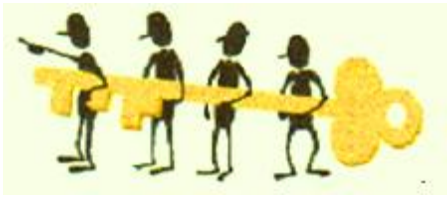
http://www.plbg.at/



„Those who do not know history are doomed to repeat it“

… D. Meister in his preface of (MEISTER David (1999)) and all who used it before...



1 Abstract

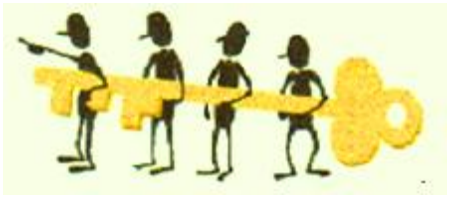
After worldwide unifying information-scientific terms (e.g. “data“, „information“) a next step can be done. Human evolutionary properties - free from overstrengthening in physical and mental way – and human behaviour in our information-dominated society is the next set of investigation. That topics are not new but they have to be brought to a philosophically pragmatic status, because IT has got immense important in last years.

A human being is a species in a long-termed evolution. His or her high level of intelligence and creativity isn't reached by any other known living organism till now. We can't change these biological laws in some years, decades or even centuries. All pseudo-human (= artificial) activities in last decades (e.g. e-memory, artificial intelligence) can't reach human levels permanently. Human borders – especially showed by interacting with computers and machines should be investigated in a common unified systematic and scientific way (e.g. American HFE, Human Orientation of IT (HO)).

IT (Information Technology) is important today in nearly all up to date Human Machine Systems. It's the first contact-level to machines. So we can say: IT is involved in steering of nearly all machines (cars, railways, ships, aeroplanes, spaces and production industries) in Human Machine Systems. Further on IT is included in all our human every day life at home and at work.

HO (Human Orientation) of IT was entitled by the author in order to take care on human needs and only on these. They seem to get lost. In historical Human Machine Systems the terms Human Factors and Ergonomics (HFE) were created before IT was known. They are the legacy background of up to date Human Machine Systems. The industrial usage is established extraordinary today all over the world. The originally militarian use is still valid.

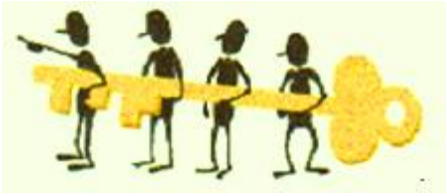
We know that the human health of mind and body has borders which should be respected in planning and design of *all* IT-systems. By using software we don't have to change all physical machines but mainly the rules how to steer them. We don't know how the future of technology of information and data transport will be but we know that human properties can't change in the same speed. If we know the human borders we can integrate them systematically in our design of software and hardware in future systematically.



The highest aim of human activity is to have joy of live and creativity. These mental goal of every human being can't be victimised to only shortly fascinating technological progress.

So let's ask what's missing in actual HCI (Human Computer Interfaces)? Is HO (Human Orientation) of IT necessary as new paradigm or was it already included by legacy HFE discipline and IT-system design?

2 Content



3 Preface

Starting with the development of Human Machine Systems a special term was created: the “human factor“ (HF). The involved human users were soldiers in wars and workers in other hazardous industries especial in USA in and after the First and Second World War (Aircraft and Navy) **(USA Ministry of Defence (1992)).**

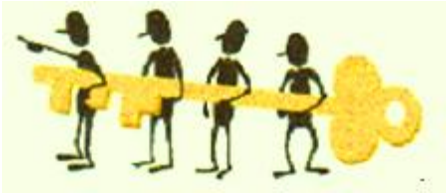
Human Machine Systems used more and more computers. Since about 1970 the selective design of HCI (the Human Computer Interfaces) got important.

By finding WWW and Internet the human contacts to PCs (Personal Computers) got much less complex by using PC-screen formats and easy languages to create them (e.g. HTML).

Since about 2010 a new topic was created: „User Centred Design“ (UCD) (e.g. in ISO 9241-210). The amount of IT-users increased rapidly. In Europe “ergonomics” - as new separate discipline in IT - was started at about the end of last century and is today integrated in all (industrial) companies by own organisational departments or at least persons.

In order to find a worldwide unifying hazard-free usability the author entitled the topic “HO (Human Orientation) of IT” in about 2007 **(PLOCHBERGER Franz (2012))** as additional separate paradigm. The word “orientation” (not in the same semantic, but by name) comes from “OO (Object Orientation)” as actual dominating software design method.

The aim of this HO-paradigm is to find general rules for protecting human properties, because IT has already conquered all areas of human life at work and at home. IT has to be absolute hazard-free because it has got part of our real whole human existence. IT should improve or even hold the mental motivation and joy for all using human – young or old, American, Asian or European. That's not easy, because IT uses physical electronic instruments. They have a much more week *live* motivation-power than human dialogue partners.



4 A view back by David MEISTER

It's not possible to change history but it's possible to learn out of it. In Wikipedia the author found a very useful book: **MEISTER David (1999)**. The author don't want to repeat but to excerpt it in an information-scientifically useful way. David MEISTER is a member of the first generation following the founding fathers of HFE as term (e.g. Paul FITTS, CHAPANIS, SMALL in the period 1945-1965).

The first mentioned literature about HFE can be found in **HFS Bulletin (April 1963) by Netherlands Economic Society** (MEISTER David (1999), p 25). MEISTER for himself tried to create a new scientific “discipline”: HFE (Human Factors and Ergonomics) between human technology and human behaviour (MEISTER David (1999), p 18 ff).

MEISTER researches a concept structure (CS) of his “HFE-discipline” by terms out of theories of Human Machine Systems like

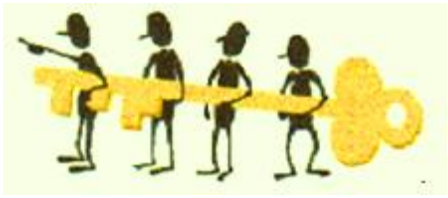
- **Signal Detection Theory of GREEN and SWETS (1966)**
- **Attentional Resources Theories of Wickens & Goettle (1984) or Wickens et al. (2004)**.

His new defined “discipline” tries to represent the knowledge of rules for developing and using all systems which touch or include human beings.

MEISTER David (1999) wrote in p. 26 ff that an important scientific source of HFE is the **Experimental Psychology**. Their main parts are human anatomy and physiology. To these sciences later on came the system-engineering sciences for creating physical systems.

He defines **factors** affecting the discipline:

- technological changes over time, including cognitive behaviour over time
- personnel training at university and in praxis
- professional organisations, their publishing and communication, e.g. HFES (Human Factors and Ergonomic Society) in USA or IEA (International Ergonomics Association) in Europe
- research funding
- job availability and
- the relationship HFE with other disciplines



As **elements of organisation** of the discipline HFE MEISTER defines

- the CS (Conceptual Structure): purpose, scope, assumptions, implications, theories and paradigms of the discipline
- general principles e.g. knowledge theory of **RASMUSSEN Jens (1983)** or task analysis by **MILLER Robert B. (1953)**
- unresolved problems
- knowledge of facts and methods
- professionals
- the operational environment
- non-technical factors: funding and jobs
- processes: development of societies, initiate research activities, publishing of results.

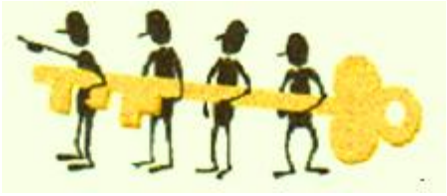
In p 34 MEISTER wrote: CS (Conceptual Structure) of HFE is still a terra incognita.

He recommends SMEs (subject matter experts). These are human experts who have practical knowledge and experience in the matter of a human machine interaction or systems.

It's remarkable that MEISTER recognises a distrust between HFE professionals and engineers for physical machine development in p 87 ff.

In p 94 ff he defines a **system** as a conjunction of human and machines (equipments). He makes differentiations between **goal and function** of that system: "*when the human acts directly on the system level (e.g. aircraft controls), the system acquires a goal.*"

In p 97 MEISTER mentioned Richard NEWMAN and wrote: "*The introduction of a computer-based technology that has a direct stimulus effect on the human through information presentation ....., means that technology now affects more humans directly.*"



4.1. System as fundamental construct – also in the HFE discipline

The term "*system"* was defined first in Antique philosophy (**PLATO, ARITOTLE, EUCLID**). They named so a public (sociological) community. You can translate the Old-Greek word "συστεμα" as "something put together".

Later on - starting at time of renaissance - it was used in French philosophy by **DESCARTES**.

Thinking in nature-scientific terms was started by the French physicians **Nicolas Léonard Sadi CARNOT(1796-1832)** or the German **Rudolf CLAUSIUS (1822-1888)**. They called their terms *Thermodynamics*.

The US-American mathematician **Norbert WIENER (1894-1964)** and the English physician **Ross ASHBY (1903-1972)** said *Cybernetics* to about the same way of thinking.

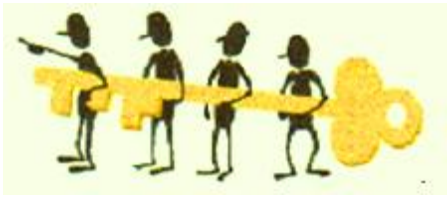
Finally the Austrian-born biologist **Ludwig von BERTALANFFY(1901-1972)** created in 1945 the *General System Theory.* He introduced *models, principles, and laws.*

MEISTER takes this term *system* into his HFE-discipline (p 89 ff). What has to be mentioned is that he combines human (sociological) systems or organisations (army, public administration departments, industrial production stuffs) and machines. He calls machines *"equipments which are served by one or more humans".*

So his HFE system is a general conjunction of humans and machines (equipments) – bound together to *one* system.

- Every system has *one purpose or goal* in which the *function* of a HFE system is ordered.
- Every system is a combination of more than one system elements or variables. In these elements can be again human and equipments.
- Human define the purpose a n d function of every system element.
- In this way of thinking it's not possible, that machines (including computers) define the function of a system or partial subsystem.

Every system and subsystem has a human purpose and not only a material machine function.



MEISTER mentions – that's important – human in HFE work together in a **hierarchy.** So the *cooperation and communication between all included human* can be developed in a predefined and structured useful way.

Following the author is adding:

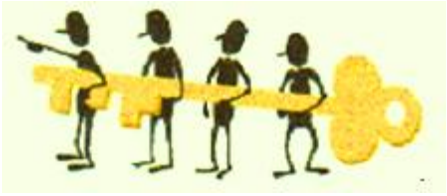
Using computers is not the same as using machines. Computers (as used till now) need and include our senses in a different way:

- more optical
- not so much acoustical
- very fine haptic (only tips of some fingers)
- not tasting
- not smelling.

Practical facts in actual Information Sciences:

- Human muscles are only needed in “soft” motion of fingers, hands and arms.
- Very much information streams into our human head through our eyes.
- In forms of “semiotic pictures (e.g. WWW-pages)” all of their manifold contents can change in a very short time.
- The amount of changing and the speed of this is not capable by human in the same way.
- That needs new learning - and cognition-habits. If we don't take care of these in a selective way, we can loose e.g. real cognition of our local surroundings or our feeling for time (**TRIMMEL Michael (1994)** or **CSIKSZENTMIHALYI Mihaly (2003)**).
- Our eyes and our brain can be overstrengthened very fast. We can be surprised by this fact at every end of work at a computer.
- We may loose motivation and joy by not using our muscles. We have a body with four limb-groups and not only eyes and brain.
- What we already know is: we need the balanced usage of all of our senses and body-elements for our long-termed healthy well being.

That's a very vast overview, we know not enough about our human borders. That's the main impact for the new HO (Human Orientation) of IT.



4.2. What's useful for HO by thinking as HFE discipline according to MEISTER David (1999), p 99 ff

Development of a new **HFE-system** needs the differentiation between two main parts

- the **goal or purpose** of the system
- the **function** of the system.

In the **goal** or **purpose** the common commercial or social needs are defined by human. Here the owner or any commercial or social group defines and gives the order what fore the created HFE-system is. A historical example is the US-government or army-commanders who ordered their ships and aeroplanes and weapon-systems as they ought them in the war.

The **function** defines how elected professional designers make a real physical system out of it. They do it as it was ordered in the goal or purpose of the system.

Both parts need human creative intelligence. That human have to be differentiated from the involved human (= users) of a system.

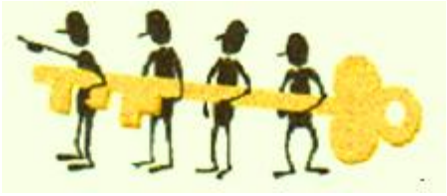
Main differentiations by MEISTER:

- every system contains **human and machines** ("equipments")
- every equipment is controlled by human
- all human are organised in a structured **hierarchy**

Every HFE-system consists of **subsystems** which are again defined by goal (purpose) and function and include human and equipments.

The way how all these elements of any system work together is called the **organisation** of a system.

The author adds that he is investigating especially the **human computer machine systems**. Most machines today are physically controlled and steered by computers (see chapter before).



4.3. Is there a difference between HFE-systems and actual IT-systems?

Reading **MILLER Robert B. (1953)** – as a classical example for HFE thinking - we can say that the information-scientific content of this method-description is still valid today. In up to date IT–architecturing-methods and IT-system-design-methods we use a concept of an IT-system in the same theoretical way.

The same theoretical contribution of human intelligence and methodology is:

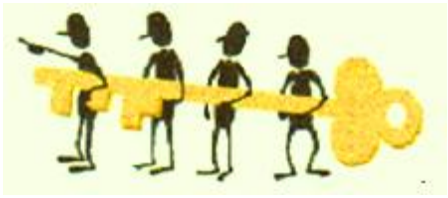
- **definition of all terms** of the concept (words and descriptions)
- **definition of all elements** of a system by using the terms
- structuring of the **organisation** of these elements in the whole system and all sub-systems
- every IT-system is or is part of a **human-machine-system**

The only difference between MILLER and actual IT-system-design is the usage of new instruments (=computers). MILLER used

- scripts - written by typewriters,
- tabel-diagrams and
- lists – manually created by pencil and ruler.

His tabel-diagrams were used as standard-forms – filled with manually written texts. The semantic of these contents stayed the same.

We can use graphical tool software to create such text-forms on our PC (Personal Computer). Additionally IT-system-development-tools in different new creatable methodologies (e.g. Ontologies) can be used today.



So we can say:

- we have a "*programmed way of thinking (artificial Intelligence)*" usable in the form of construction tools on all levels of development but we need still the human intelligence for creating, maintaining and changing our actual systems.
- HFE-discipline-thinking brought first ideas and rules, how to create human-machine-systems.
- Up to date architecturing and development of systems has reached a very high level. Every IT-specialist educated by academical teachers can learn these during his study.
- A new scientific profession was born: the ergonomic or HFE specialist for best integration of a human being in machine (equipment) – systems.
- The knowledge of this profession has to be definitely human orientated (HO).

5 Actual IT world

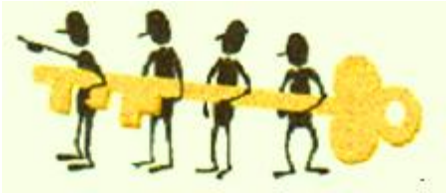
Today (2014) in the working world every serious company has a an ergonomic group to manage medical care. The main goal in medical prevention is to avoid bad stress. This is one main reason for getting e.g. cancer or the Burned-Out-Syndrom. IT – if not used ergonomically – can cause stress (e.g. the bad distress) too.

Therefore in actual IT "*ergonomic activities*" (e.g. EUROPEAN Agency for Safety and Health at Work, ERGONOMIE und Arbeitsschutz in Germany or ERGONOMIE der Österreichischen AUVA) in Austria are already in use.

IT-design is supported by international design rules: ISO existing in manifold ways (e.g. ISO 9241). Look at ISO homepage, their content is and will be updated every week.

The leading U.S. activities can still be found originally at HFE Society.

Leading worldwide and e.g. European activities can be found too under International Ergonomic Association (IEA).



Since about the 70th of the last century development of software got the most important part in creation of IT-systems. At the end of the last century even software-tools and -frameworks were created. These tools can create software in a common standard of IT-system-design-method. This standards include HFE-knowledge.

The main style of software design is done today in object orientated (OO) software languages (C++, Java et al.). But they had consciously no fluent (continuous) connection to previous formal methods and a lot of mixtures were created in order to use both paradigms.

All these together brought a broad knowledge in analysis and design methods (= architecturing in using software-systems).

Today every scientific PhD publication at universities in Europe or USA brings a combination of some old or new “methodologies” (knowledge bases, Ontologies or proprietary graphical systems).

So evaluation of concepts and system-thinking is quite well-known on IT-specialists level.

A legacy well known revolution brought the WWW (world wide web) and Internet (BERNER-LEE at CERN).

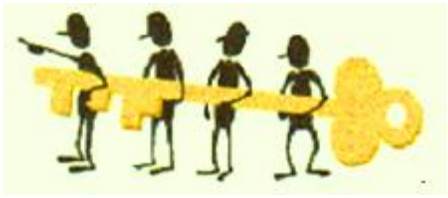
At least “ubiquitous computing” by mobile handy access to central server-stored data is the state of the art. New little applications (Apps) can be programmed very easy and bring all these stored data to one single mobile instrument (e.g. handy, smartfone, notepad).

The new goal is now to get secure and reliable data. Data as new value – after hard- and software – gets precious.

In the Age of Information the topic Human-Computer-Interaction (HCI) changed in last years into direction human being. Human Centred Design (HCD) researched methods to set human in a qualified position again. In my feeling these activities are yet up to date but still too superficial.

The biological properties of human beings which have biological evaluation-times can't be overplayed by designing new up to date IT-software. This software has today a duration of a half to maximal three years. IT has to respect human behaviour in general. So we have to find a definitive explicit paradigm for designing software for human information-behaviour and properties and try to find these human borders in form of general rules for all Human-Computer-Machine-Systems.

Of course human can be trained to an IT-system but e.g. demotivation can come soon, if it brings only monotone replications (**TRIMMEL Michael (2003**), p93 ff).



Every human being is a living creative person which would like to have always new – less or more - individual challenges. In first terms of HO these needs e.g. got the name “living software design”.

6 What brings Human Orientation (HO) of IT?

The author has the same way of thinking as MEISTER in HFE discipline development. But he would not dare to define a new discipline. The author thinks first about writing down a new paradigm or orientation.

The aim of HO (Human Orientation) of IT is a new set of terms and perhaps rules which should be included in future IT systems. Every IT-system gets his information from a human being. The rules how human need IT-systems must be found. What we know today is that we can solve nearly every problem by our IT-tools.

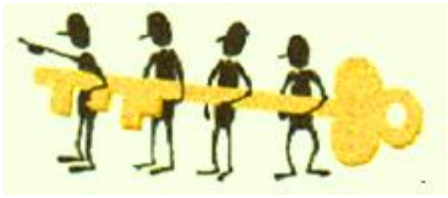
We need an orientation how human need IT *in general*. How an IT-system has to be designed in the interface to every human (amount, speed and style of information). We have till now only an uncountable amount of possible solutions.

HO of IT has the defined aim to protect human properties in a general preventive way. A kind of basis knowledge about these human properties has to be collected. The human intelligence tries in every moment to adapt more and more his habit but there are definitive biological and mental borders. The line between these borders is not yet known.

Machines and artificial systems can be changed as they are needed at work and in human life. Every change of an artificial IT-system brings a new usability and new enforcements for our human behaviour. Artificial systems (machines, computers and surroundings) have generally no limits in their development - involved humans h a v e borders.

In our time - the second decade of the Age of Information - we feel that human can't follow all artificial systems as they could be developed.

But handling of time and an amount of information (based on data) can be done under a certain level only. So we have to design our artificial systems which grow more and more complicated consequently within these human borders, we have to orientate our design in direction human properties – and not only in (commercial) goals of a human machine system owners.



That's new, because till now we designed IT as the paying owner ordered it. In UCD (User Centred Design) we include the human being already, but only as a fix programmed software unit (constant user-entity, user-role or persona, e.g. Jacob NIELSEN by his Web-Usability). But humans are more. They have creativity and feelings and their long termed behaviour can never be constant like machines.

On the way of investigation of HO-terms we have one advantage: all found human properties can change only in the same speed as the biological evolution of our species. So we have enough time to find them.

One new found term is e.g. our “cognitive evolution”, the permanent growing of knowledge of all human on our planet as difference to the “biological” one. The term “technological evolution” as amount of knowledge about artificial instruments of all human in the world (deep or tight specialized) is in most connections similar to the term “cognitive evolution”. This evolution has much more fast changing-times. His complexity is not definable in any way, we can't know definitely what will come. Historically our evolution of technological knowledge in Europe came from Old-Greek-Classic, went to the Orient and came since about 1000 a. C. in the period of Gothic over Spain to the European continent again. After Second World War the leadership in “technological evolution” especial in electronics and IT went to US-America (good economical basis, one language, no historical and cultural restrictions).

Only in theoretical sciences we have a worldwide investigation in all disciplines in different temporary leading countries (e.g. finding of DNA-code).

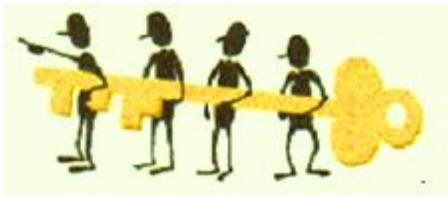
HO – coming out of physics and informatics – includes per se also other sciences : Psychology, Sociology, Economy, Communication Sciences, Biology, Human Life Sciences, System Theory, Philosophy and Ethics.

The empirically reached rules for IT-system design in the last decades (Human Factors, Ergonomics, HCI, UCD) are still valid but we need a more general abstract paradigm for the future. It's possible because the base is only changing in human evolution times.

More and more complex usage of information is bound to human properties: creativity, intelligence, mental borders and biological laws.

In last years in Europe “Information Sciences” as theoretical basis for future usage of artificial and informational systems tried to find worldwide unifying terms (**HOFKIRCHNER Wolfgang (1999)**, Raphael CAPURRO et al.).

Combining Systems Theory, Philosophy and Information Sciences brought in last years a possible “theoretical” unification of the terms “data” and “information” (**PLOCHBERGER Franz (2012)**).



That's one starting point of the HO (human orientated) paradigm within this new Information Sciences.

Every problem in IT of present time can be solved technologically. In order to find a solution, we need only enough IT-professionals, time and money!

The important thing is to know what is to in the future for all our human on our planet – for the human being in his borders as a biological species!

We have the new possibility to *communicate between all peoples* on earth by all our new media in all their appropriate cultures. We have to divide the knowledge about all coming new ways of thinking.

They don't bring us the paradise again, because the well known human characters and interests will be in future too – good and bad - even with new media and HO-IT (e.g. security and confident usage of data). So we have to maintain also human Ethics and Moral in future under these new conditions.

By IT we got a new instrument - like the book at the time of GUTENBERG. For coming centuries **we got a new chance only**. We can use these new media - for our save or our perdition!

The question is, how to do it in a human (orientated) way, for the benefit of the human species.

7 Conclusion

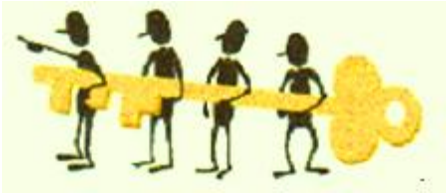
We can obviously answer now to the question in last lines of chapter 1:

- HFE - as MEISTER designed it - is a useful scientific discipline. So HFE-research can be done permanently.

- HFE is today already too large and complex to get an unified or structured overview. But it can be a theoretical base for single HFE-systems.

- This embedding of HFE-discipline in new Information Sciences is done. The found results of HFE are surely biologically and related to human species.

- The selective effective using of HFE-terms in war situations are today mostly transferred into civil usage.



- HO of IT - as the author researches it - is an orientation or paradigm - *no discipline.* It can be seen as part of CS (Conceptual Structure) in HFE discipline of MEISTER.

- HO of IT is actually *no* new methodology in Information Sciences.

- HO of IT is not yet finished, but it's a new impact in Information Sciences.

- HO of IT is important for all future use of IT by human - and machines behind.

- HO of IT is based on worldwide unifying scientific theories of Information Sciences.

- HO of IT investigates human biological and mental behaviour and has an “biological evolutional” speed of challenges. A genuine human “cognitive evolution” is not fundamentally important for the goal of HO but is included = it's an useful temporarily changing adjective.

- So HO of IT can and will be a long termed successful research area. Till now that's not done in a compound form on scientific level.

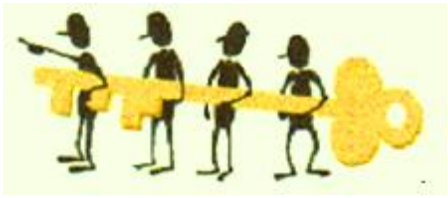
8 References

CSIKSZENTMIHALYI Mihaly (2003), Franz PLOCHBERGER, writing in German about “Flow-Feeling” seen out of Information Sciences, 2012, "Flow seen out of Information Sciences"

GREEN and SWETS (1966), Signal Detection Theory and Psychophysics, by D.M. Green & J. A. Swets, 1988, reprint edition published by Peninsula Publishing, Los Altos, CA 94023, USA

HOFKIRCHNER Wolfgang (1999), Cognitive Sciences in the Perspective of a Unified Theory of Information, International Society for the System Sciences, ISBN 09664183-2-8, 1999

MEISTER David (1999), The history of Human Factors and Ergonomics, 1999, Lawrence Erlbaum Associates, Publishers, Mahwah, NJ 07430, ISBN 0-8058-2769-2



MILLER Robert B. (1953), A method for man-machine task analysis, June 1953, Wright Air Development Center, WADC Technical Report 53-137, Ohio, USA

PLOCHBERGER Franz (2012), Axiome der Informationswissenschaft, Franz PLOCHBERGER, http://www.plbg.at/Werke/deutsch/Axiome der Informationswissenschaft.pdf
or in English
http://www.plbg.at/Werke/english/Axioms%20around%20the%20term%20Information.pdf

RASMUSSEN Jens (1983), Skills, Rules, and Knowledge; Signals, Signs, and Symbols, Jens RASMUASSEN, Senior Member IEEE 1983, Riso National Laboratory, 4000 Roskilde, Denmark, Manuscript

TRIMMEL Michael (1994), Computertätigkeit und Realitätsbezug, Seite 224-228 in Psychologische Forschung in Österreich, Universitätsverlag Carinthia Klagenfurth, Hsg. Herbert Janig, 1994, ISBN 3-85378-434-8

TRIMMEL Michael (2003), Angewandte Sozialpsychologie, Manual, Facultas Verlags- und Buchhandels AG, Wien, 2003, ISBN 3-85114-779-0

USA Ministry of Defence (1992), The MANPRINT Handbook, 2nd Edition, Controller HMSO, London, 3.December 1992

Wickens et al. (2004), An Introduction to Human Factors Engineering, Chapter 4, by Wickens, Christopher D., Second Edition, ISBN 0-13-183736-2, Pearsons Edition, Inc., 2004

Wickens & Goettle (1984), Multiple resources and display formation: The implications of task integration, by Wickens, C. D. & Goettle, B., Proceedings, 722-726