Human System Interaction with Confident Computing. The Mega Trend

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Keynote Abstract: This keynote will give an overview of the last 30 years of human system interaction and the key elements of Human Computer Interaction (HCI) and its transition from traditional HCI into the frontier of Human System Interaction (HSI). This leads to the discussion as to why HSI is about Digital Ecosystems and about the world we live in rather than just ICT. We explain the 5 Mega Trends, and the emergence of Confident Computing and how that is leading to the revolution of the next generation of Human System Interaction version 2.0 and Usability version 2.0. This is followed by the challenges and research issues within Human System Interaction (HSI).

I. Where we were and where we are

Here we give an abstract definition of what lies between Human Computer Interaction (HCI) and Human System Interaction. This will help us to distinguish the two and understand where we were and we are now.

HCI is referred to as an end user interacting with a computer or a machine through graphical user interfaces (simple definition) (see figure 2).

HSI is referred to as an end user or consumer interacting with technology-based system(s) or embedded computer devices through interactive protocols or modalities such as audio, video, hearing, feeling, vision, touching, sound, voice, vibrating, reading, writing, tagging, blogging, binding etc.. all human sensations (See figure 2).

The distinction between the two lies under the definition of Human, - who do they both refer to; system or computers, - what are the differences between the two; the interaction protocols and what do they include. The above definitions distinguish between the two. It is obvious that Human System Interaction requires a much larger scale of emphasis and automation on 'system' and 'interaction' and it is where the challenges are.

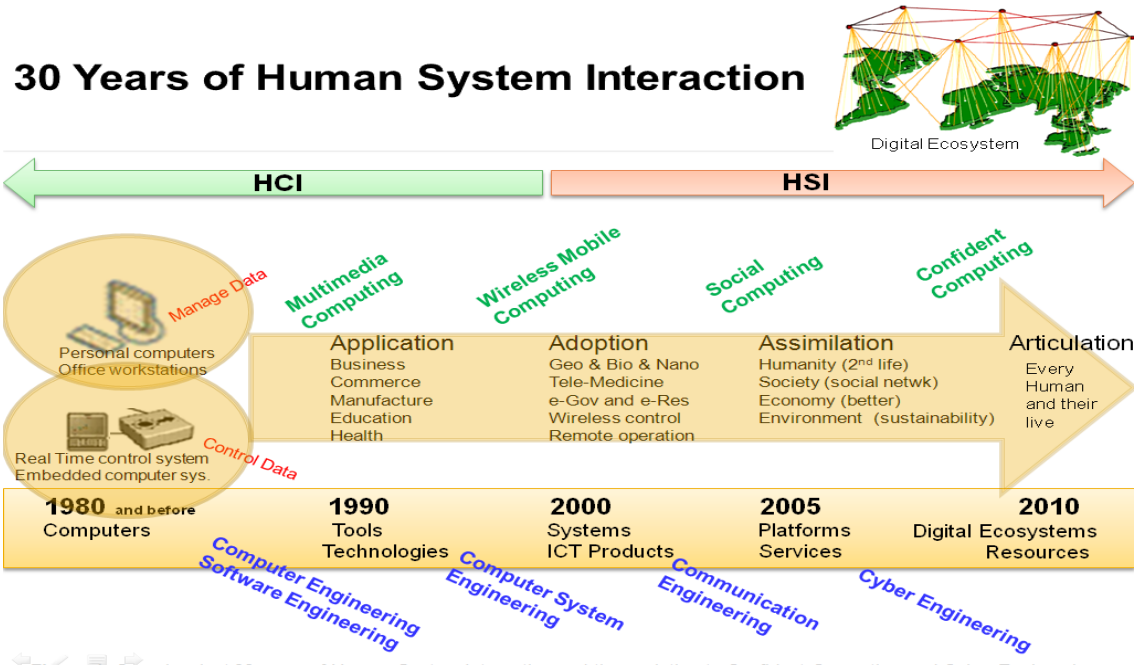

Figure 1. Overview-last 30 years of Human System Interaction and the evolution to Confident Computing and Cyber Engineering

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II. 30 years of HSI evolution

An overview of 30 years of human system interaction and its evolution leading to confident computing and cyber engineering is shown in Figure 1.

The two board types of computer systems and their evolution. In our world, there are two types of computer systems, (see the 2 circles in Figure 1) one used to *manage the data* such as databases, web applications, etc. and the other used for *control and data monitoring* such as embedded computer systems, devices and real time systems.

These two types of computer systems evolved in the same way in the last 30 years. By the 1990s, the maturity of the technology enabled wide application deployment in Business, commerce, manufacture, education and health. In the 2000s, advances in technology penetrated to all new field of studies, such as Bio-medicine, bio-informatics, bio-tech, bio-chem, geo-information sys, geo-physics, nano-technology, tele-medicine, e-business, e-gov., e-resources, as well as wireless communication, control and remote operations. At around 2005, technology intruded into every part of society, economics, environments and humanity; and nowadays, technology has sneaked into our pockets, living rooms, no matter where we are, it is with us and with every part of our lives.

The evolution of technology penetration – 4 As. Over the last 30 years, there are 4 stages of technology penetration (4-As), namely: wide application in the 1990s; wide adaptation in the new field of studies in the 2000s; wide technology assimilation and amalgamation in our society and environment at around 2005; and now, with such strong technology penetration, we need articulation of the technology sentiment for every part of our human life.

The evolution of technology principles. In the 1980s and before, we focus on computer functions and interfaces for human users; in the 1990s, we moved to the modular approaches for tools and techs to help business and organizations; in the 2000s, we target objects and component based approaches to deliver agile and reusable ICT products to sustain ICT industries; at around 2005, we shifted to service oriented computing and platforms to sustain all parts of the networked economy; and for the next 5-10 years, the trend is toward resource-oriented computing and the *environment we live in*, also known as the ***digital ecosystems*****,** and help these to improve human life, our life.

The evolution of computing, from what computers can do to what humans can do. In the 1990s and before, the main stream of Human System Interaction effort for both types of computer systems has been on *Multi-media and virtual reality*; followed by the 2000s, *wireless and mobile computing*; followed by *social computing* at around 2005, where self-organized social structures emerged as new societies and focused on creating value by making connections and now we are moving to the era of ***Confident Computing.*** The emphasis here is the study of what humans can do rather than what computers can do [2], and deals with all aspects of human psychology which bring about technologies such as trust, privacy, security and collective human intelligence [5].

The evolution of engineering from the end of the computing era has led to the beginning of cyber engineering. Between the 1980-1990s, it was the era for *computer engineering and software engineering*; between the 1990-2000s, it was the *computer system engineering* era; between the 2000-2005, it was centred on *information and communication engineering*; and between now and 2020, it will be the *Cyber Engineering* era.

Cyber engineering studies the digital horizon in our ecosystems. It encompasses ideas such as Cloud computing. The motivation is on how they improve our human lives, not just organizations, business and government. It *studies the world we live in*, and *personal space computing*, our space, personal space, between the digital skyline and our ecosystems.

The advent of technologies and networks have brought about a *narrow single field* of study of computing as an end in itself leading to disciplines, such as computer science, software engineering or IS [5]. A *multi-discipline field* of studies emerged in the 2000s, in which one or two fields of studies are combined to achieve better outcomes. Since 2005, a wide spread "*inter-disciplinary*" approach has taken off, where the intersection between human endeavor, advanced ICT and business or other domains' systems are amalgamated, leading to cross fertilization between fields of studies which generate unique opportunities and quality outcomes.

The departure of HCI and the arrival of HSI. Before the 2000s, it was the human computer interaction era, where you are assumed to only interact with computers, or machines, or devices, or robots, or the WWW, or environments, or platforms; but now, we are interacting with an integration of many of the

above- the *system*, the ***digital ecosystem***, the next generation of *socio economic environment* where every one of us is living in. We want the technology for humans, ourselves, and our world.

III. HCI, HWI, HSI 1.0 and HSI 2.0

The core of Human Computer Interaction

From the early days of computing and software systems between 1970s-1990s, Computer Interfaces (UI) played a crucial role in the success of the system. The traditional view of the human computer interface was for its use in standalone computers or a computer which was part of a closed local area network. Important research issues that had to be addressed in order to facilitate a smooth interchange of data between user and computer include:

1. system feedback
2. consistency of the interface
3. error prevention
4. error recovery
5. performance issues related to the interface
6. dislike of the interface

These issues are also referred to as **UI features**, usability criteria, or usability factors and some times they form UI design guidelines or golden rules.

The core of Human Web Interaction (HWI)

The study in this area is also covered by Web Engineering, which largely deals with all sorts of web applications, including e-business, e-marketing, e-entertainment, e-education, and e-government etc.

The criteria 1-6 laid out for the traditional UI also apply to Human Web Interaction, however, several additional **UI features** have to be added and these are:

7. Navigation
8. User control
9. reliability

The core of Human System Interaction 1.0

The Human System Interaction 1.0 refers to the current or last version of Human System Interaction.

The strong development of power electronics has resulted in the focus on *Extreme Interfaces* design, which deals largely with the human interaction with control systems for factory automation, hospitals, the disabled and aged care, supply chain, education, and the household environment, etc. Often these interfaces are found on dedicated computer based machines, devices, tools and systems. Apart from above features 1-9, a new set of extended **UI features** are developed to address the system interaction issues, namely:

10. attractiveness
11. interactivity
12. user experience
13. internationalization
14. customizability
15. dependability
16. flexibility

The above features 1-16 apply across all type of computer systems including the computer/systems that *Manage the data* and the ones that do *Control and data monitoring*.

There were several difficulties with characterizing these features because of their fuzzy nature. An effective approach to design and evaluation of these traditional user interfaces using fuzzy systems theory is given in [4]. Another important issue for these traditional UIs (User Interfaces) was how to capture the user interactions with the system using an automated approach. An effective approach to doing this is given in [6] and this has been patented. Over the last few years, traditional UIs have to a large extent, been supplanted by web interfaces. Essentially this has meant replacing the 'fat' client on the UI by a 'thin' client with the major part of the UI being downloaded for a particular application or web interaction [3]. Research challenges for extreme interfaces still remain today with respect to poorly designed interfaces which, apart from user discomfort can lead to risk, result in reduced business productivity and safety concerns. Safety issues pertaining to human day to day operations are paramount.

The core of Human System Interaction 2.0

In the above sections, we outlined a total 16 features that applied to HCI, HWI, HSI 1.0. We analyze the current availability of research work and summarize it in the table below:

UI Features	Research Field	Status
Feature 1-6	HCI	*past*
Feature 1-9	HWI	*past*
Feature 1-16	HSI 1.0	*now*
Feature 17+	HSI 2.0	***next***

The above table indicates that despite the success in the human system development and empowerment of interaction technologies, new requirements and new needs emerged, and a new Human System Interaction version 2.0 is required to meet the next 5-10 years of human needs. In order to introduce HSI 2.0, we first look at the **5 mega trends** in ICT today.

The Following Table (Figure 2) presents the contrast between HCI and HSI

Human Computer Interaction (HCI)	Transition	(HSI) Human System Interaction
Human is referred to as end-users who use computer to do their jobs	→	Human is referred to as customer, consumers and everyone on the planet who uses the systems to support their living, work, family and the "2nd life".
Computer is often referred to as a Machine	→	System is referred to as an integration of technology and tools which may contain applications, hardware, software, embedded devices, platforms, network, or web
Interaction is referred to as graphical user interfaces, dialogs and screen designs	→	Interaction is referred to as reading, writing, seeing, showing, hearing, touching, feeling, sensing, audio, vibration, sound, voice, mouth operated, blogging, tagging, searching, publishing, finding, binding, etc.
Primary focus: software itself, stand alone and intranet applications	→	Primary focus on the platforms, services, products, real time, and environments
Studies from a Computer point of view: User Interface Analysis, Design, Implementation, Testing, Usability Evaluation, Metrics, Usability Testing	→	Studies from a System point of view are: Interactive platform architectures, user experience design, confident computing, trusted environment, dependability, accountability, autonomous reasoning, assistive technology, etc
Studies from the End User point of view: Human factors, software psychology, User-centered analysis and design, Ergonomics and Cognitive, etc	→	Studies from Customer and Consumer point of view, semantics analysis and representation of data, information and content, creating value though connectivity, creativity and innovativeness, knowledge discovery and information sharing, etc
Golden Rules: ease of use, consistency, user friendly, system feedback, user like/dislike, error prevention, error recovery	→	Golden Rules: user experience, user participation, individualism, personalization, openness, interactivity, automation, amiableness, visualization, sensation, etc
HCI studies the technologies, methodologies, tools and approaches		HSI studies the world we live in, to have more convenience, more products, more services, more choices, more options, etc
HCI controls user as to what to do, how to do it, what to do next, where you were, where you are now and where you should be	→	HSI empowers the customers DIY, DEY, DEFY, BYO, self service, self org, self reliance, self assessment, etc
HCI is about what Computers can do	→	HSI is about what Humans can do
HCI focuses on computer 'intelligence'	→	HSI embracing the collective human intelligence

Figure 2. The Transition from HCI to HSI

IV. The Five Mega Trends and HIS 2.0

More recently we are seeing thenew impact of human systems interaction (HSI) with the advent of the web and new forms of system implementation. In order to understand this impact, one has to take into account the 5 mega trends in ICT and their use in different areas of human endeavor, and these are:

a. The Tsunami of Data
b. Ubiquitous Digital Living
c. DIY, DEY, DEFY, BYO, SFY and SS
d. Web 2.0, 3.0 …
e. What human can do

We discuss each of them in turn.

a) Mega Trend 1- The Tsunami of Data

In recent times, we have seen that total enterprise data has grown from megabytes 1990, and gigabytes 1995, terabytes in 2000, petabyte in 2005, and now exabyte in 2007 and we will see zetabytes in 2010. Structured data are shrinking from the traditional over 50% in the 1990s to about 5% in most organizations in 2010 [5]. In addition, there is a tsunami of data and information from the web breaking into our lives. In 2006 alone, there was 161 exabytes (10^8 TB) of information created or replicated worldwide, and that is more than all the data that were created in the previous 5,000 years all together, and over 5 web pages of data and information for every man, woman and child on the

planet and there will be a 6 times growth by year 2010 and after that, doubles every 2 years (M. Brodie, keynote speech at IEEE DEST2008 [2]). The on-line population reaches now represents the 3rd largest country in the world in 2008, just behind China and India. The largest Data source is UGC (User Generated Content), which will be increased by 50% in 2010 [2]. Two strong forces are driving this mega trends: the end-user and the Web. The data is using us and are we are not yet using all the data

b) Mega Trend 1- Ubiquitous Digital Living

Digital is ubiquitous and around us everywhere. It is in our living rooms, in our cars (GPS etc), in our offices, in our pockets, in our skylines, in our ecosystems, in our businesses, in our collaborations. There are endless digital possibilities, and opportunities. Digital signifies connectivity, empowerment, higher quality, accuracy, speed, efficiency, better performance, low-cost and light weight, larger capacity and small size. It is the digital system attracted by the end-users and it is also the end-user attracted by the digital systems.

c) Mega Trend 3- BYO, DIY, DEY, SFY and SS

Our society is moving from "unified society to Individual society" [32]. With the advent of Web and its intrusion into commerce, it has transcended the traditional, rigorously defined closed collaborative environments, such as centralized (client-server) or distributed models (such as peer-to-peer) or hybrid model (such as web services) into a self-organized, interactive environment which offers cost-effective digital services and value-creating activities that attract human, organizational and software agents that participate in and benefit from it. Several terms could describe this new interactive paradigm as BYO, DIY, DEY, DEFY, SFY, SS.

BYO= Build-your-own (build your own Dell computers), or Be your own, etc
DIY= Do it yourself
DEY= Do everything yourself
DEFY= Do everything for yourself
SFY = let the system speak for you, serve for you, sell for you, etc
Ss =self service, self sustain, self survival, self reliance, self organize, self management
These items form part of the concept of Confident computing

d) **Mega Trend 4-Web 2.0, 3.0 …**

Web 2.0 is a philosophy. We need to think of Web as a platform of services. Applications are built by composing services. Users add "extra value" to these services through deeper level of participation for their own benefits. Social software encompasses *software that supports group interaction* (Shirky 2003). Self-organization and communities of individuals evolve into an Emergent structure (Dron 2006). We are now moving from a traditional closed competitive environment to a more open, loosely coupled, collaborative environment, where each organization and individual is proactive and responsive for its own benefit**.** The new environment facilitates value creation by making connections through the use of the modern networked infrastructure supported by different forms of collaborative IT frameworks. Social software binds the discrete societies into connected special interest groups, self-organizing communities have emerged into new socio-economic entities, the connectivity and Web 2.0 generate new age collaborative humanities. Today, we see that data and information are exploding, content is accumulating, on-line users are booming, services are diversifying, and interactions are entertaining, heterogeneity and complexity is intensifying, the issues with privacy, trust, dependability, risk, accountability and security are magnifying. These items form part of Confident Computing.

The major thrust for this has come through the use of Web 2.0 Basically one can consider " Web 2.0 as an attitude or philosophy" [23, 21, 27]. There has been a sharp movement from considering the web as a read only web where the web site creator decides the content that the user will be able to consume toward a "read -write "where the user can now create content as well as consume content. This philosophy has lead to a plethora of social networks such as YouTube and Facebook. Here users post content that they have created in an interactive fashion so that it can be shared with other users. While web 2.0 treats the web as a platform on which to carry out interactions. Web 3.0 will embed meaning and semantics and the environment is named digital ecosystems. The present approach of service oriented computing will be complimented by resource oriented computing.

Social networking is the process of connecting and sharing information within a group of people who have a certain degree of similarity. [10,11]. Thus people with common interests, background, career, hobbies, goal could form a social network. Social networking is facilitated by HTTP, RSS/Atom, and Scripting. For example, social bookmarking websites often employ simple HTTP protocols, AJAX, and RDBMS to realise online social networks. RSS/Atom and HTTP is the only essential technology needed to build a user-friendly blogging system with millions of online bloggers and communities. Wiki is another example of using simple Web-based technology

(HTTP and Server-Side Scripting) that enables people to engage in remote collaboration to form goal-directed social networks. [11,19]. This has added a new dimension to Human System Interaction

e) Mega Trend 5- From *what the Computer can do* to *what the Human Can do*

There has been a significant Paradigm shift related to IT in that it is now increasingly focused on domain centred and demand driven problem solving underpinned by IT rather being focused on solving IT related problems on their own. This has brought into play a whole new group of techniques and methods that help with this domain centred problem solving. User are now in control, consumers drive the universe, it is not the product, or services or business.

What do these mega trends mean? It means we are shifting to HSI 2.0 with Confident Computing.

V. HSI 2.0

Nowadays, the system makes us to do things ourselves, or you make the system to do things for yourself. So the new age system have the features that enables individual society to grow, such as strong emphasis on Personalization, Individuality, Empowerment and Humanity. All of these items are related to Confident Computing, we now list these new features for HSI 2.0

17. Ss: self organize, self learning, self recovery, self fulfillment, self sustain, self survival, self evolving (personalization)
18. BYO: DIY, DEY, DEFY (individuality)
19. SFY: speak for you, sell it for you, serve everything for you (empowerment)
20. Safety: trust, privacy, security, risk, accountability (humanity)

Therefore, we can summarise the differences between HSI 1.0 and HSI 2.0 in the follow table below:

HCI, WI, HSI 1.0	HSI 2.0
studies tech, methods, tools, approaches	studies the world we live in
empower computers	empower humans
what computer can do	what humans can do
computer Intelligence	Augmented human intelligence

VI. Confident Computing

Confident computing refers to the building of systems that empower humans through ambient intelligence. It is building the technology for humans. It has strong features of personalization, individuality, self empowerment and humanity which address the psychological warchest of human concerns about the technology such as safety, trust, privacy, security, risks and accountability.

In summary

- Confident computing studies the world we live in. It brings about improvement in human life, society and economics through technology.
- Confident computing is about what humans can do, rather than what computers can do.
- Confident computing is about embracing the collective human intelligence rather than computer intelligence
- Confident computing inspires the techs to empower everyone on the planet to overcome psychological concerns and barriers.
- Confident computing helps the transition from "Unified society to Individual society" [Ohnishi HSI2008]
- Confident computing addresses human concerns, such as trust, privacy, safety, security, risk, accountability

Confident computing answers the following key questions

- Does the system facilitate personalized need?
- Does the system permit individuality?
- Does the system speak for you or provide the service for you? Such as if you build a website, does it SFY?
- How safe is the system, what is the measure of this?
- How does the system ensure privacy of information?
- How much should we trust the interactive devices, products or services?
- What are the risks involved in these interactions?
- How much risk do we face or know about?
- Who is accountable if something goes wrong?

Successful resolution of these questions leads to confident computing in Open Systems of the sort found on the web. How the above elements can be addressed, and breaches in them can be captured quickly. This represents a new dimension of human system interaction through confident computing that transcends previous notions in human computer interaction and allows the conduct of human system

interactions with confidence through the use of Confident Computing [5]. In order for a human to interact with a system with confidence, one needs to finesse the distinction between the following elements: security and protection; risks and trust, privacy and confidentiality; trust in products, services and service providers; risk assessment and the consequence of the failure and accountability [7, 8, 21, 22, 28,29].

Privacy and Security*: Privacy* and privacy protection is different to security, individuals are empowered to protect their own information. She/he must have the power to control information about him or herself (Privacilla 2003) and s/he must exercise that control consistent with his or her interests and values". *Security* mechanisms exist to protect human or data from attack or unauthorized access of data, though security mechanisms, security technology and security services

Trust and Security: *Trust* is the belief or faith that a agent (human or machine) has in another agent (human or machine) in a given context and at a given time to perform as expected. In order to acquire trust in another entity, security mechanisms could be used. *Security* in the context of computer system interaction refers to the process of enabling a sheltered environment for an agent (human or machine). Agent (human or machine) could abuse the trust of the other in the secure sheltered environment.

Risks and Trust: *Risk* evaluation involves the initiating agent to determine *beforehand* the probability of failure and the consequences of failure to its resources involved in the interaction. *Trust* evaluation measures the belief that the agent has in another agent in attaining its desired outcomes. This does not take into consideration any losses. We define the possible Risk in the context of HSI as a combination of: The probability of failure in the interaction, the consequences of failure (in all terms), and the loss of health or finance probability in the Interaction.

Accountability: it means there is always someone, or something, that is responsible for certain undesirable event or result. Service Accountability means that a service deployed should impose an obligation or willingness to accept responsibility or to account for one's actions. (K.J Lin 2007)

These elements are of paramount importance to build consumer confidence whether they are in the networked economy at large or the shop floor in the form of evolutionary manufacturing systems or in a disability nursing home with Pathfinder or walking compass or extended enterprises through platform interaction.

VII. Usability 2.0

Traditionally, usability is used to measure the interactivity and usefulness of a system. It usually measures the system with qualitative information on:

- Ease of use
- Ease of learning
- Ease of control
- friendliness

However, these powerful techniques and measures are no longer suitable for HSI 2.0 and Confident Computing.

Example 1: Blind assistive devices/systems

Although, many systems/product are available: such as sonar sweeping, Ultrasonic signals + synthetic audio signals, Laser measurement mounted on the long cane, Ultrasonic head-mounted spectacles, Ultrasonic sensor attached to the long cane, Swept ultrasound signals to locate objects ahead then return frequency sound/signals via earphone, there are no. solutions yet for the Long Cane that warns of drop-off such as a hole in the ground, curbs, stairs, - the challenge is that we can use it, but this is not totally helpful because it cannot prevent drop-off. So the traditional usability measure is not helpful.

Example2: Blind assistive devices/systems

The demand for e-Learning will be increased rapidly and by 2025 up to 150 million people would be seeking e-Education (Thao and Chang 2008). The "e-Learning system" should provide services in the pedagogical way. Is the system such that you are able to learn something, rather than just provide 'ease of use'. We look for "effectiveness" of the system rather than "usability".

The challenge lies that in the past, we only measure product, now, everything is about services and platforms, and there is no usability developed for this new set of technologies. Figure 3 depicts the distinction for this.

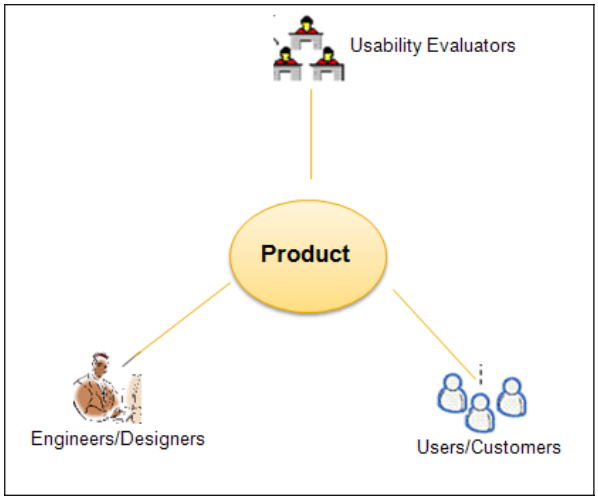

Figure 3a. We have Usability for Product measure

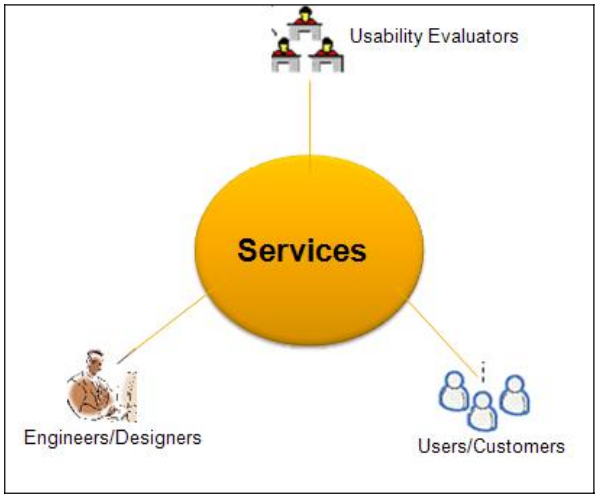

Figure 3b. Today we do not have Usability for Service measure (need Usability 2.0).

V. Research Challenges in HSI

a) Design to provide Services

Systems and Applications are built by composing services. In considering Web 2.0, we note that Web is a platform of services rather than a system or an application. Users add "extra value" (both content and capabilities) to these services through deeper level of participation for their own benefit. Web2.0 principles have several important implications for Human System Interaction. Service composition is the key for building applications and for users. In Web 2.0, service composition is frequently achieved through **Mashup** which are Web applications that combine information from several sources and provide that through simple Web APIs. Mashup plays a key role in forming a Virtual Organisation. One can distinguish between Service mashup (data level on the server-side) and User mashup (Meta data level on the client-side) which can facilitate the user-centred Virtual Organisations. Thirdly users at varying levels (i.e. end users, domain experts, IT professionals) can all contribute during their participation. Mashup is defined as *a website or Web application that seamlessly combines content from more than one source into an integrated experience* [Jackson, Wang 2007]. Mashup, in its nature, is a Web-based composition approach that allows end users (vs. professional developers) to create their own applications in an efficient manner without dealing with sophisticated techniques and specifications. To our understanding, Mashup represents a radical 'simple' way of developing a distributed software application. The implication of such a user-centred software development approach is very significant. It means that the service consumers can create and try out 'self-service' whenever needed and possible through integrating existing information services across the Web [10].

b) Design for Multiple needs

The design of Extreme Interfaces must assume the possible multiple needs of a business customer as a paradigm. For example, in many human disabilities requirements, there may be multiple extreme demands. It is often the case that a person does not have one disability in isolation, ie: a Cardiovascular Accident (stroke) victim may often suffer loss of speech accompanied by paralysis of the left side of the body. It may therefore be necessary to offer special purpose displays and single switch input (possibly triggered by the head etc if full quadriplegia is the case). This would be on top of delivering a suitable synthetic speech output for the user.

Another example is about all-in-one wheel chairs. Currently, there are outdoor chairs, beach chairs, indoor chairs, all separated into so many options, not only is this not economical, but it is inconvenient for the elderly and disabled.

In the office, we prefer 5 in 1 systems, rather than many separate products which may use up a lot of space and cumbersome interfaces.

Another example is the long cane for mobility aids for the blind. This may convey little or no detail to the user with respect to position or object identification. They may warn of an obstacle in the forward vicinity of the user but may often use harsh buzzers, simple warning vibration or synthetic tones

as the user interface display. They do not warn of drop-off (such as a hole in the ground) in any reliable way. Some long canes may have enhanced range and precision, such as laser based types, but again with a far too simplistic binary switch **go/no go** indicator. Some complex sonar sweeping techniques convert reflected ultrasonic signals into a synthetic but *inhuman* audio signal that is presented to the user. These systems are often rejected in favor of the standard Long Cane commonly used by the blind, because of cumbersome controls and require substantial learning and therefore compromise acceptability. They also frequently deprive the user of direct hearing of the environment.

Design for Human Perception

Humans are analogue, not binary with respect to perception. An example in the Hospital situation, many have go/no-go displays which usually have a simplistic warning sound and /or a vibrating unit that signals the user. Some simpler examples gather distance information by using an ultrasonic transceiver but are head or chest mounted. They buzz at one set distance and produce a high pitch beep at a fixed closer range. This binary warning is hardly user friendly. This is unfortunately a typical example of treating the user as a machine, or at least with little understanding and secondary to the design consideration. Sometime, this could prove dangerous for a user who *thinks* she is using the best system on the market.

Design for Convergence of Technologies

An example of convergence technology systems is GPS coupled to a digital map interface and digital compass. The display uses voice synthesis. These aids fall into a category of their own. They are not stand alone but totally dependant on another system. They have a place in giving wider orientation cues to the user, but do not give close up orientation cues or warn of immediate danger such as steps or drop offs. However, sometimes, they compromise ambient sound signals to the user.

Design for Security and Safety

Security has been with computing environments from the early days. In the case of Information System and the Platforms, it includes amongst other things: (information piracy, copyright protection, traitor tracing, ownership verification, secure communication, authentication and authorization, intrusion detection, secure & invisible storage). Whilst many of these issues have been with us from the early days, the advent of the internet with open systems has introduced new and difficult challenges which must be addressed. In the case of embedded system interaction, security refers to a safe and secure environment.

Design for Privacy

This is best highlighted by considering two incidents that have occurred in the last few years. The first incident occurred "between 2002 and 2003 Jet Blue Airways released millions of customer records to a private US Department of Defense contractor, which merged that data with data from a different source to identify possible terrorist suspects, directly violating Jet Blue's privacy policy" [16]. The second incident relates to "DSW Shoe Warehouses revealed that it had lost about 100,000 data records containing personal information, including credit card numbers and other personal data, which were used for fraudulent activity" (Consumers' Union 2005). One could go on giving several horror stories of this sort in relation to violations of privacy. Preservation of privacy is in the vital interest of companies, organizations and consumers, with violations of privacy leading to personal and financial loss. There are several issues that arise from "the inherently open, nondeterministic nature of the web" and the "complex, leakage-prone information flow of many web-based transactions that involve the transfer of sensitive, personal information" [1]. Privacy and privacy protection is different to security in that individuals are empowered to protect their own information so that (1) s/he must have the power to control information about him or herself [24] and (2) s/he must exercise that control consistent with his or her interests and values". Security mechanisms exist to protect data from unauthorized access, authentication, encryption or signatures, etc. This issue has led a strong focus on benchmarking and understanding privacy issues. An important step in this direction has been the development of a Privacy Ontology [28, 29].

Design for Trust and Dependability

The issue of trust takes on special significance because of the increasing advent of commerce on the internet. Trust assessment on the Internet is complicated by the fact that in the real world one can use various physical or facial cues, rely on a document or referral to known authorities such as credit agencies or government to inform the process of trust establishment, whilst in the Digital World one is faced with the absence of physical cues and the establishment of centralized authorities such as certification authorities is still evolving and may not always be applicable. Trust and Security are two distinct concepts in that Trust is the belief or faith that a agent has in another agent in a given context and a given time to perform as expected. In order to

acquire trust in another entity, security establishing mechanisms are used. Security refers to the process of enabling sheltered communication between two communicating entities or providing a sheltered environment. Parties could resort to unfair practices over the secure communication. A thorough and detailed study of Trust and Reputation in Service Oriented Environments is given in the recent book by Chang, Dillon and Hussain [7]. Trust and Reputation Ontologies are discussed in [7,8].

Design for Failure Management

A related issue here is the risk that one is exposed to when carrying out an interaction on the internet. When considering risk on the internet it is important to take several factors into account and these include [28,29]:

- Uncertainty in obtaining the desired outcomes.
- The probability of failure of the interaction.
- The consequences of failure (in financial terms),
- The Loss of Investment Probability in the Interaction.

Detailed mechanisms for calculating such risks are given in References [7]. The definition of risk and its assessment method is context and domain specific. Risk is determined by taking into account failure probability distributions of different levels of interaction and the investment probability distribution and convolving these to calculate the loss of investment probability and the extent of loss over interactions. These are then used using two different approaches namely fuzzy inference and possibility theory to ascertain the risk involved and to provide an answer to the question given the level of risk should one proceed with the interaction.

Trust and Risk should be distinguished from each other in that:

- Risk - evaluation involves the initiating agent to determine beforehand the probability of failure and the consequences of failure to its resources involved in the interaction.
- Trust - evaluation measures the belief that the initiating agent has in another agent in attaining its desired outcomes. This does not take into consideration the financial losses of the interaction.

Design for Accountability

Another key issue is Accountable Computing. This is a concept introduced by K.J Lin and his co-workers at UC Irvine [22]. It addresses the following questions:

- Do you know about the services you are receiving?
- How did it happen?
- What went wrong?
- How costly is the result?
- Who is to blame?

Accountability means there is always someone, or something, that is responsible for certain undesirable event or result. Service Accountability means that a service deployed should impose an obligation or willingness to accept responsibility or to account for one's actions [22]. A detailed consideration of accountable computing is given in [22]

VI. Conclusion

In this paper we identified the megatrends which are taking place and are producing a tectonic shift in the way human system interaction has to be viewed. These megatrends have introduces the need for confident computing to address psychological wars among human users towards technologies. We emphasize the next ICT paradigm is for humans, for ourselves, not just for the organization and business or government. It is for the world we live in, not about what computer can do and cannot do, it is about what humans can do. We highlight the need for Usability 2.0. Web 2.0 3.0 have introduced new forms of interactivities and new form of systems throughout the Web. They have facilitated new organizational forms of interaction between humans through the advent of social networks. These have introduced new challenges which have to be addressed through the paradigm of Confidential Computing with its important elements of Security, privacy, trust, risk and accountability.

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