**Human-AI Teaming**

*FlexTech International Industrial Spring School*

*May 29-31, 2024 - Biarritz, France*

# *Human-Technology Symbiosis in Smart Environments Empowered by Participatory Design and Co-Creation*


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# About the speaker

Dr. Dr. Norbert Streitz (Ph.D. in physics, Ph.D. in cognitive science) is a Senior Scientist and Strategic Advisor with more than 35 years of experience in ICT. Founder and Scientific Director of the Smart Future Initiative launched in 2009. Norbert held positions as Deputy Director and Division Manager at the Fraunhofer Institute IPSI in Darmstadt, Germany, for more than 20 years and was a Lecturer at the Computer Science Department at Technical University Darmstadt. Before, he was an Assistant Professor at the Technical University Aachen (RWTH). Norbert was a post-doc at the University of California, Berkeley, a visiting scholar at Xerox PARC, Palo Alto, and at the Intelligent Systems Lab, MITI, Tsukuba Science City, Japan. He published or co-edited 39 books/ proceedings and authored/ co-authored more than 170 papers. His activities cover a wide range: Cognitive Science, Human-Computer Interaction, Experience Design, Hypertext/Hypermedia, CSCW, Ubiquitous Computing, Ambient Intelligence, Human-Centered AI, Privacy, Industry 4.0, Automated Driving, Hybrid Smart Cities, Smart Airports, Smart Islands. Norbert was a PI of many projects funded by the European Commission as well as industry. Norbert is an elected member of the ACM CHI Academy.
https://www.smart-future.net/norbert-streitz

**Note 1**

This is a modified / edited version of the slides used in the talk.

**Note 2**

The first three slides on mental models were not part of the initially planned talk
but inserted for the talk to address the discussion on models during the Spring School.

# Selected References


Christine Riedmann-Streitz, Norbert Streitz, Margherita Antona, Aaron Marcus, George Margetis, Stavroula Ntoa, Pei-Luen Patrick Rau, Elizabeth Rosenzweig (March 2024).
How to Create and Foster Sustainable Smart Cities? Insights on Ethics, Trust, Privacy, Transparency, Incentives, and Success. *International Journal of Human–Computer Interaction.* https://doi.org/10.1080/10447318.2024.2325175 (open access)

Norbert A. Streitz, Christine Riedmann-Streitz, Lúcio Quintal (2022). From 'Smart-only' Island towards Lighthouse of Research and Innovation. In: *Proceedings of the 10. International Conference on Distributed, Ambient and Pervasive Interactions: Smart Environments, Ecosystems, and Cities. (DAPI 2022)*. pp. 105 - 126. Lecture Notes in Computer Science LNCS 13325. Springer. https://doi.org/10.1007/978-3-031-05463-1_8 .

Norbert A. Streitz, Christine Riedmann-Streitz (2022). Rethinking 'Smart' Islands towards Humane, Self-Aware, and Cooperative Hybrid Islands. *Interactions*. Vol. 29 Issue 3 (May-June Issue 2022). pp. 54 - 60. ACM Press. *https://doi.org/10.1145/3527200*

Norbert A. Streitz (2021). From Smart-Only Cities towards Humane and Cooperative Hybrid Cities. *Technology | Architecture + Design*. Vol. 5, Issue 2 (Special Issue on Intelligence). pp. 127 - 133. (Taylor & Francis). DOI: 10.1080/24751448.2021.1967050

Norbert Streitz (2019). Beyond 'Smart-Only' Cities: Redefining the 'Smart-Everything' Paradigm. *Journal of Ambient Intelligence and Humanized Computing*. vol. 10, no. 2, pp. 791-812. (Springer). DOI: 10.1007/s12652-018-0824-1

Norbert Streitz (2017). Reconciling Humans and Technology: The Role of Ambient Intelligence. Keynote Paper. In: A. Braun, R. Wichert, A. Mana (Eds.), *Proceedings of the 2017 European Conference on Ambient Intelligence*. Lecture Notes in Computer Science (LNCS 10217), Springer (pp. 1-16).

*On mental models:*

Norbert Streitz (1986): Cognitive ergonomics: An approach for the design of user-oriented interactive systems. In: F. Klix and H. Wandke (Eds.), *MACINTER I – Proceedings of the First IUPsyS Network Seminar on Man-computer interaction Research*. North-Holland, Amsterdam. pp. 21-33

Norbert Streitz (1987) Cognitive compatibility as a central issue in human-computer interaction: Theoretical framework and empirical findings. In G. Salvendy (Ed.), *Cognitive engineering in the design of human-computer interaction and expert systems*. Elsevier, pp. 75-82.

Norbert Streitz (1988). Mental Models and Metaphors: Implications for the Design of Adaptive User-System Interfaces. H. Mandl & A. Lesgold (Eds.). Learning Issues for Intelligent Tutoring Systems. Springer. (pp. 164 – 186)

# Outline -- *Food for Thought* --

- The Five Helices of the Quintuple Helix
- Human-/Humanity-Centered Design Approach
- From HCI to HEI: Designing in the Large
- Seven HCI Grand Challenges:
  - #1 Human-Technology Symbiosis
  - #2 Human-Environment Interactions
- 17 UN Sustainability Development Goals (SDGs): #11 Sustainable Cities
- Cities as Complex Living Organisms
- The 'Smart-Everything' Paradigm – Problems caused by AI/ML
  - 1. Design Trade-off: Human Control and Empowerment vs. Rigid Automation
  - 2. Design Trade-off: Privacy-by-Design vs. Importunate Smartness
- 'Smart' Cities as 'Self-aware' Cities
- Beyond 'Smart'-Only Cities => *Humane, Cooperative, Hybrid Cities*
  - Co-Provision, Co-Creation, and Co-Exploration
- Participatory Design and the Example of the Design Café (Copenhagen, 2023)
- Summary

# *Preface on System Design*:
# Mental and Conceptual Models – 1. Order

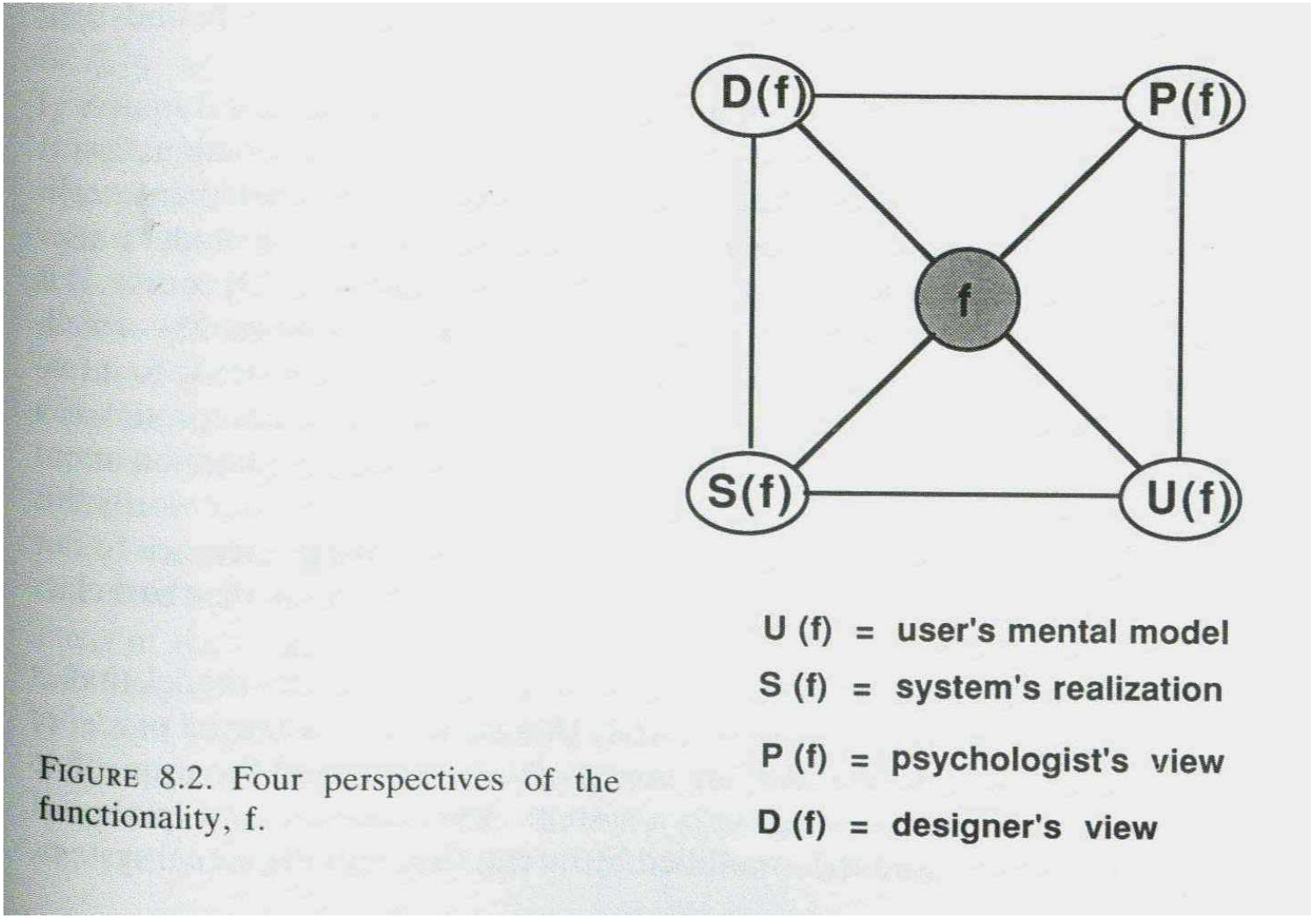
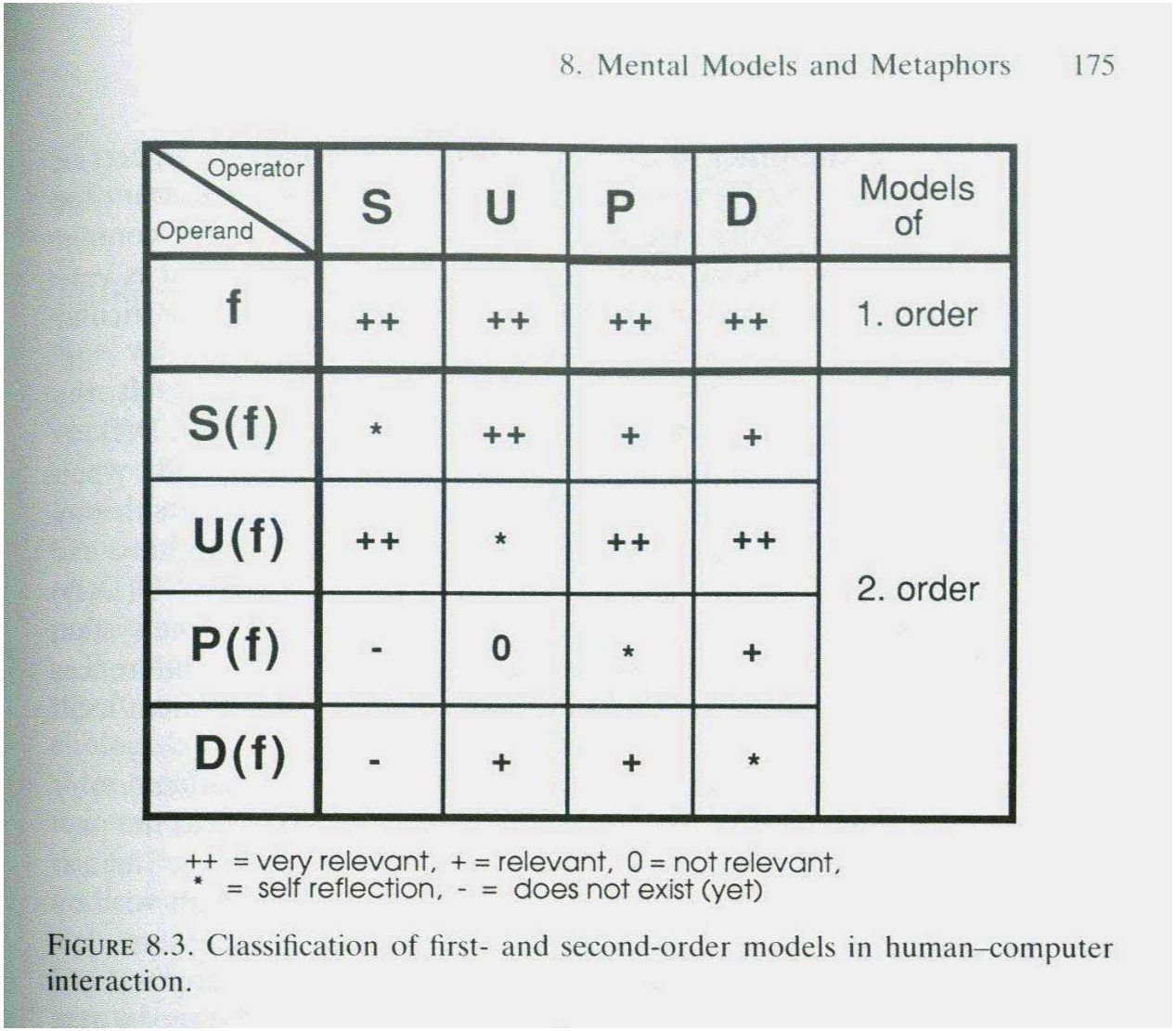



FIGURE 8.2. Four perspectives of the functionality, f.

N. Streitz (1988). Mental Models and Metaphors: Implications for the Design of Adaptive User-System Interfaces. H. Mandl & A. Lesgold (Eds.). Learning Issues for Intelligent Tutoring Systems. Springer. (pp. 164 – 186).

# Mental and Conceptual Models – 1. and 2. order



8. Mental Models and Metaphors 175

| Operator / Operand | S | U | P | D | Models of |
|---|---|---|---|---|---|
| f | ++ | ++ | ++ | ++ | 1. order |
| S(f) | * | ++ | + | + | 2. order |
| U(f) | ++ | * | ++ | ++ | |
| P(f) | - | 0 | * | + | |
| D(f) | - | + | + | * | |

++ = very relevant, + = relevant, 0 = not relevant,
* = self reflection, - = does not exist (yet)

FIGURE 8.3. Classification of first- and second-order models in human–computer interaction.

*Examples:*

D(U(f)) =
designer's model of the user's mental model

D(S(f)) =
designer's model of the system's realization

U(S(f)) =
user's model of the system's realization

P(U(S(f))) =
psychologist's model of the user's model of the system's realization

N. Streitz (1988). Mental Models and Metaphors: Implications for the Design of Adaptive User-System Interfaces. H. Mandl & A. Lesgold (Eds.). Learning Issues for Intelligent Tutoring Systems. Springer. (pp. 164 – 186).

# Cognitive Ergonomics & Cognitive Compatibility

Thesis on achieving **Cognitive Compatibility** (Streitz, 198,1987)

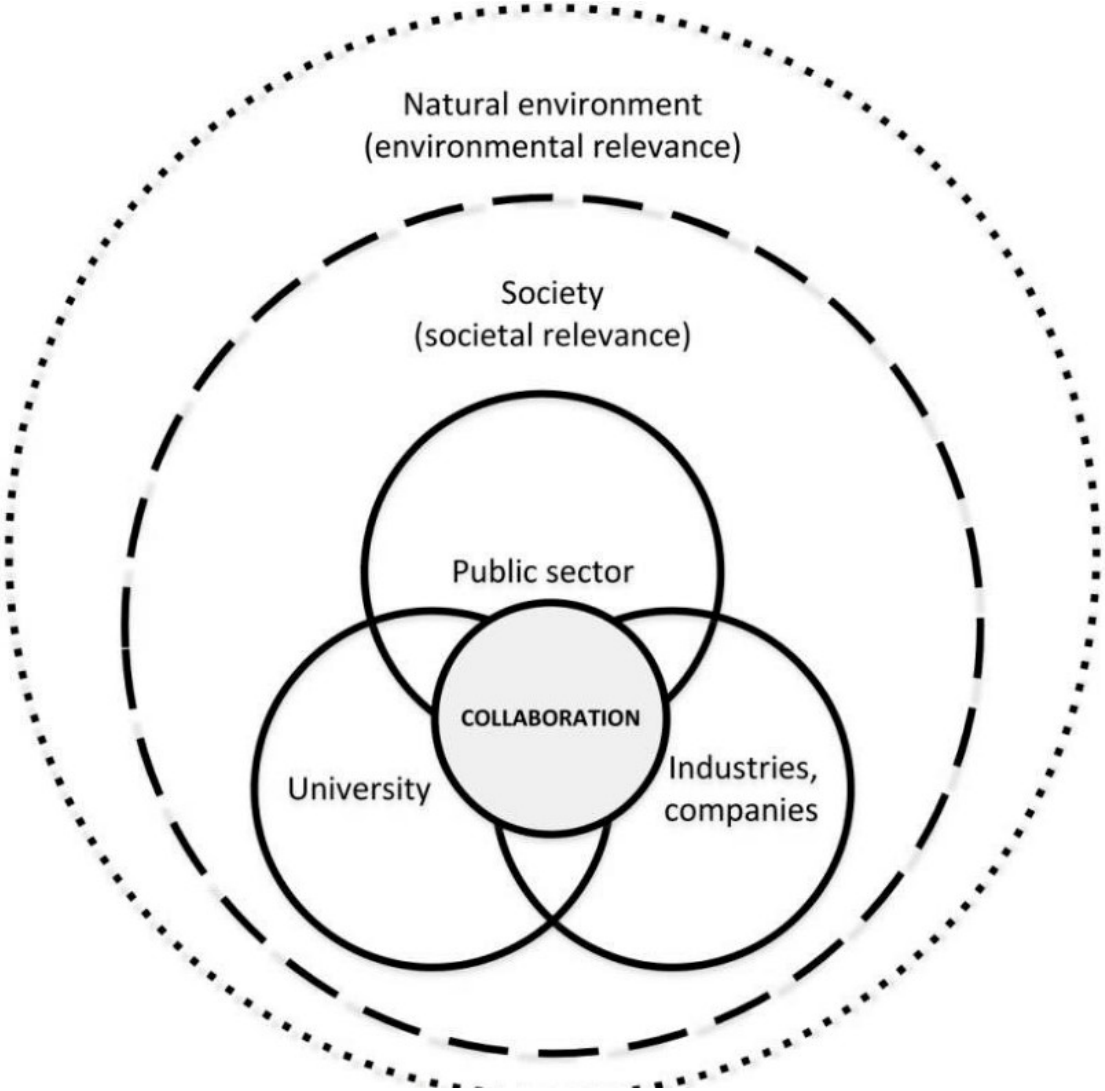
*An interactive computer system is the more user-oriented the less discrepancies exist between the relevant knowledge representations (models):*

- *before* designing/realizing the system
  => between D(f) and U(f)
- *after* the system's realization
  => between U(S(f)) and S(f) and D(f)
  and U(S(f)) and S(U(f))

*Cognitive Compatibility and Mental Models can play a useful role for providing transparency of AI systems*
*=> human-centered / humane/ explainable AI*

N. A. Streitz (1987) Cognitive compatibility as a central issue in human-computer interaction: Theoretical framework and empirical findings. In G. Salvendy (Ed.), *Cognitive engineering in the design of human-computer interaction and expert systems*. Elsevier, pp. 75-82.

# Context: The Five Helices of the Quintuple Helix



# Innovation Economy ⇔ Creative Environments

*Position of "Innovation Economists"* (based on Joseph Schumpeter's ideas):

- Economic growth is the main driver in today's knowledge-based economy.
- It is not capital accumulation as neoclassical economics asserts, but innovative capacity spurred by appropriate knowledge and technological externalities.

*Economic growth in innovation economics is the end-product of*:

- Knowledge (structural, declarative, procedural, heuristic and meta knowledge; codified vs. tacit/implicit knowledge)
- Regimes, policies, leadership allowing for entrepreneurship and innovation ( => R&D expenditures, permits and licenses)
- Technological spillovers and externalities between collaborative firms.
- Cooperative Value Creation (CVC), collaborative agile work & common success.
- Systems of innovation that create innovative environments ( => clusters, agglomerations and metropolitan areas).

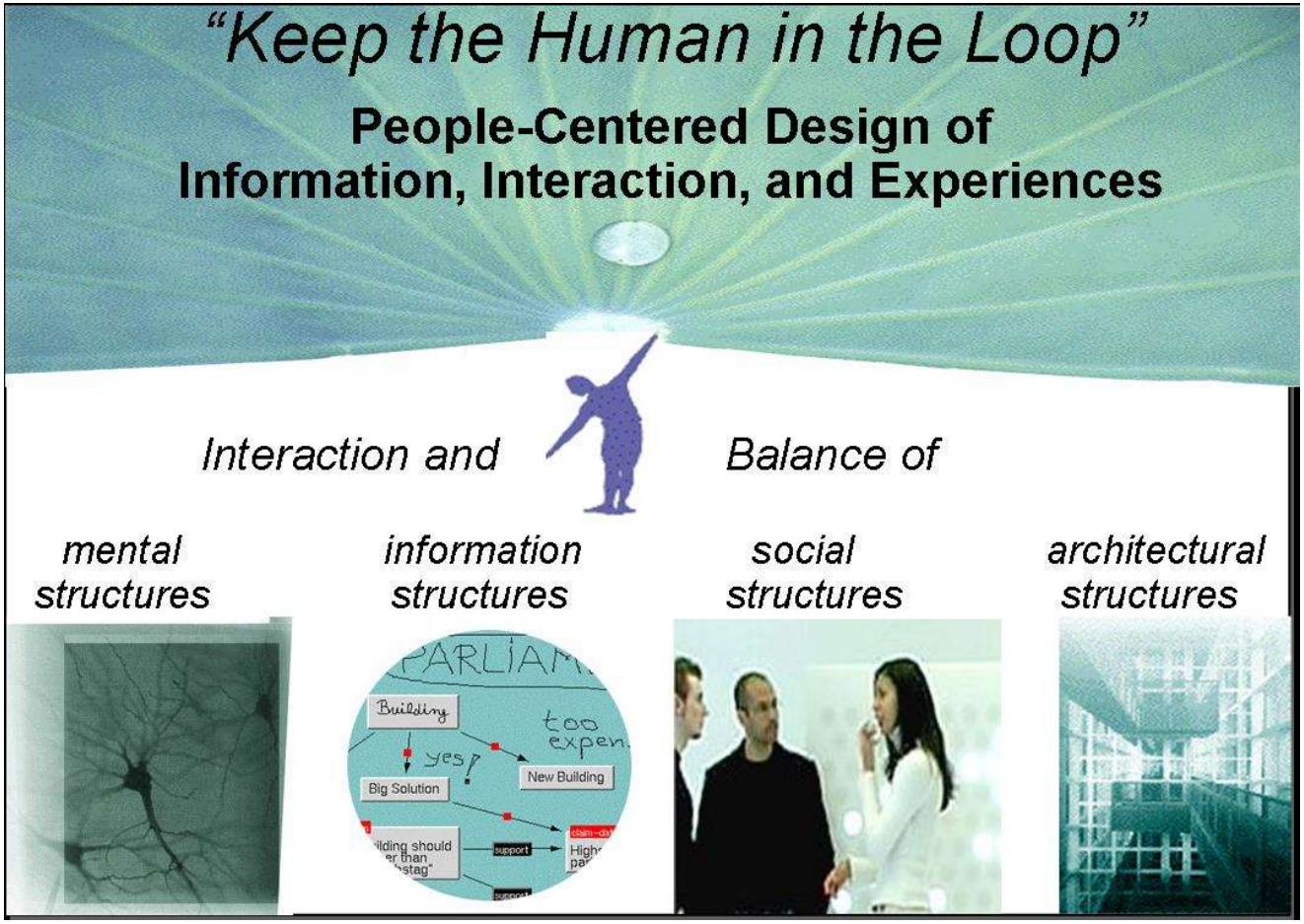
Example: Goal of our Design Cafés in Madeira (2021) and Crete (2022):
How to transform an *Island* into such a "place to be" by facilitating a creative environment providing the key factors? => Transforming Madeira into a *Lighthouse of Research & Innovation*.

# Human-/Humanity-Centered Design Approach

Interdisciplinary Approach & Teams

- Architecture
- Art
- Computer Science
- Design
- Economy
- Engineering
- Psychology
- Sociology

(*in alphabetical order*)




***Designing virtual and physical / hybrid interactive environments***

***Human-Centered AI is one application of this general approach and mindset***

# Range of Design Perspectives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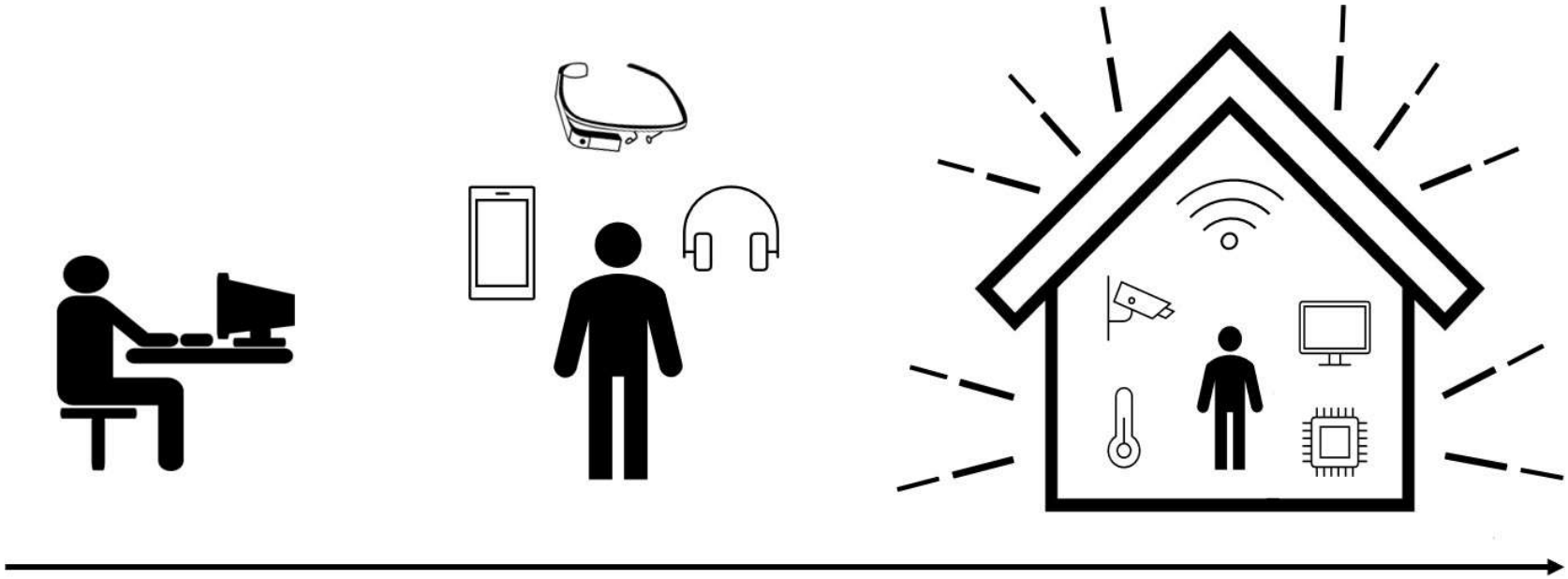
# From Desktops to Wearables to Smart Buildings/Spaces



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**Buildings and Spaces constitute Cities and Environments**

**Smart Cities & Islands are Hybrid Environments**

# HCI => HBI => HEI => HAII …

- From Human-Computer Interaction (HCI)

  to

- Human-Building Interaction (HBI)

  *(home - office building – school – theatre/ cinema - stadium - …)*

  to

- Human-Environment Interaction (HEI)

and then there is and will be increasingly:

- *Human-AI Interaction* in instrumented, smart environments

# Excursus: Social Architectural Spaces

- Private Spaces
- In-between Spaces
- Meeting Spaces
- Transient Spaces
- Public Spaces
- Transportation Spaces
- Third Places (Spaces)

# *Roomware*® Components (1998 - 2000)

developed by **IPSI** with Wilkhahn as our main partner in the FOD-project

*www.roomware.de*

*Paper at CHI'99*

DynaWall® CommChair® InteracTable® ConnecTable® Passage connected and operated via the cooperative BEACH software.

# 1. Point of Departure: The Seven HCI Grand Challenges


**Constantine Stephanidis, Gavriel Salvendy, ……, Norbert Streitz, … (2019). Seven HCI Grand Challenges. International Journal of Human–Computer Interaction. Volume 35, Issue 14, pp. 1229-1269. DOI: 10.1080/10447318.2019.1619259**

# Challenge 1: Human-Technology Symbiosis


*Symbiosis* (Greek for *"to live together"*) refers to defining how humans will live and work harmoniously, cooperatively, and respectfully together with technology.

Technology is or will - in the near future - exhibit characteristics that were typically associated with human behavior and intelligence, e.g., natural language understanding, learning, reasoning, problem solving, pattern recognition, …
*But*: let's keep in mind that these capabilities (facilitated by AI / ML) are usually limited to specific application domains.

# Three Types of Symbiosis

- **Mutualism**

  Symbiosis in which both parties benefit from their coexistence.

- **Parasitism**

  Symbiosis where one party benefits,
  while the other party suffers disadvantages.

- **Commensalism**

  Symbiosis where one party alone benefits and the other party neither receives benefits nor incurs disadvantages.

- *This differentiation raises issues for discussion who benefits*.

# Challenge # 2: Human-Environment Interactions


Issues:

- Interactions in the physical and digital continuum
  => ‘hybrid’ worlds/ environments
- Disappearance of the ‘computer’ as a ‘visible’ distinctive device
  => ‘calm technology’, but privacy issues
- Embedded interaction via smart wearable devices, such as glasses, watches, and bracelets
- Implicit sensor-based interactions, e.g., gesture-based interaction with large interactive walls/ displays
  new notion of affordances
- Novel and escalated interactions, exploit sensing the environments and simulating human senses
- Interactions in public and transient spaces, where the ubiquity of technologies “blurs” the boundaries between private and public spaces/ interactions
- Interactions in virtual and augmented reality

# 2. Point of Departure for Smart Environments: UN Sustainability Development Goals (SDGs)


https://sdgs.un.org/goals

# Selected SDG:  # 11 Sustainable Cities

# Cities as Complex Living Organisms / Environments

- *Cities are complex systems with a large number of networked entities, communicating and interacting with each other.*

- Complexity results from the diversity of contributing and participating entities and their relationships:
  - living organisms like humans, animals, plants, ..
  - ‘bricks and mortar’ and other artefacts constituting the physical environment like buildings, bridges, streets, rivers, vehicles, etc.
  - active artefacts with embedded IoT components controlled by software increasingly based on machine learning
  - virtual counterparts or ‘digital shadows’ of basically all organisms and artefacts (depending on appropriate models) constituting *hybrid environments*, e.g.,
    - digital twin cities; networks of people with their social relationships in the real world as well as in the virtual world.

# Future: Floating City - OCEANIX in Busan, South Korea


all images by BIG-bjarke ingels group

OCEANIX plans a floating city in South Korea's port city of Busan as the first location to host one of these futuristic habitats. OCEANIX Busan aims to demonstrate that coastal cities facing severe land shortages compounded by rising sea levels can adapt to such threats, using breakthrough technologies. When built, the three interconnected platforms, totaling 15.5 acres, will provide homes for a community of 12,000 people. Design by Bjarke Ingels Group (BIG), Copenhagen and New York.

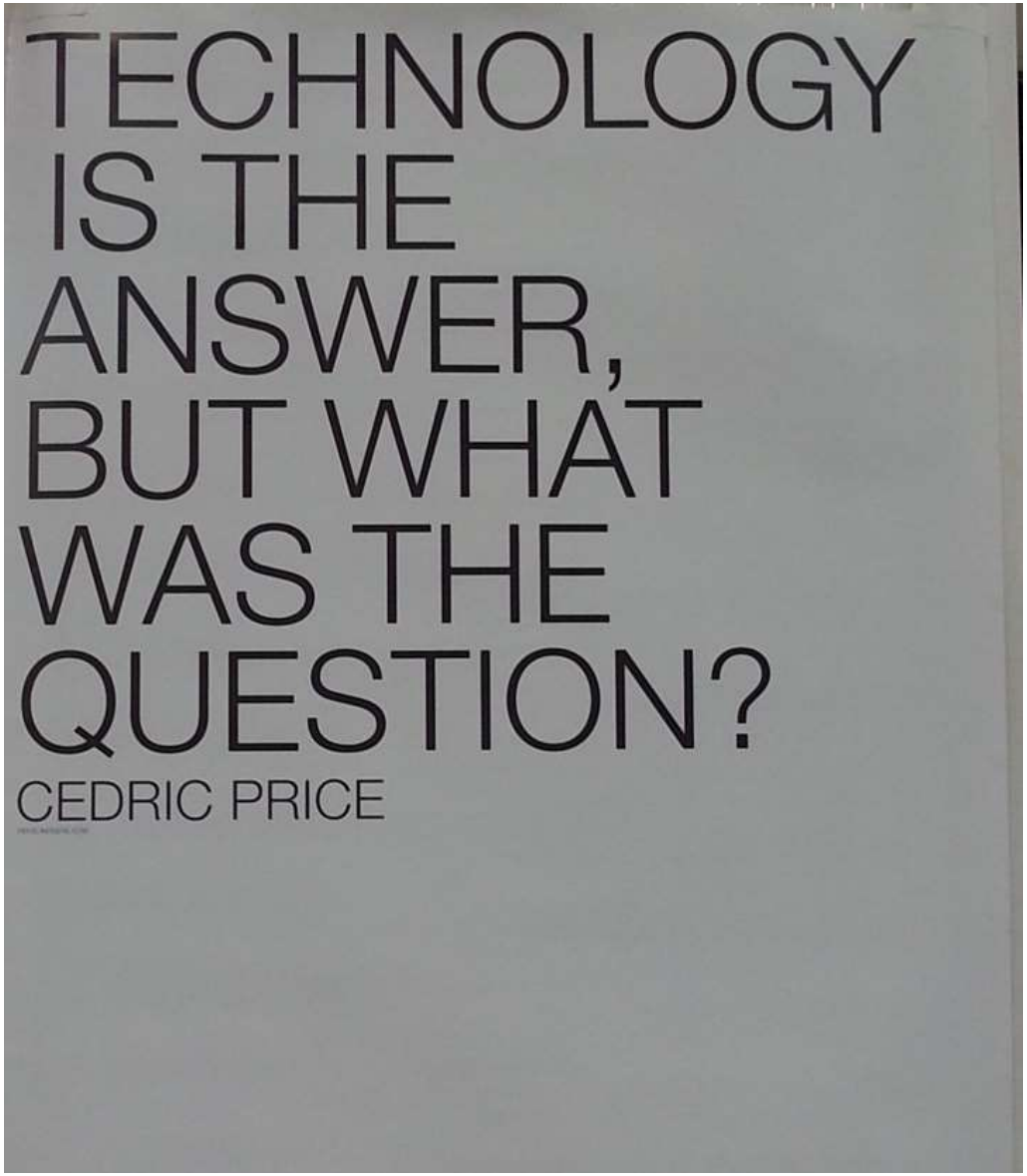
https://oceanix.com/busan

# Design Approach

- *UNESCO - Report: Smart Cities - Shaping the Society of 2030*
  Three Concepts of Urban Progress:
  - ***Business City – Economy First***
  - ***Eco City – Ecology First***
  - ***Citizens City – Humans First***
- Any smart city should be a balanced combination of these three dimensions, but the mix is always dominated by a *primary purpose*.
- My focus: vision, common purpose, values, design trade-offs for putting ***Humans First*** *based on a* ***Citizen-Centered Design***

Credit: Chuttersnap, Unsplash.com

# Cedric Price – British Architect (1934 – 2003)



# The '*Smart Everything*' Paradigm*

- Everything must be "smart": phones, cars, cities, …
- IoT provides ubiquitous infrastructure instrumenting environments (smart buildings, smart city, ...) with sensors and actuators and increasingly with smart materials.
- Artificial Intelligence (AI) / Machine Learning (ML) provides the software level acting on IoT infrastructure at a ubiquitous scale.
- Result: Smart Devices and their algorithms facilitate and control processes, services, devices, and thus our environments.
- *Humans are increasingly removed from being the 'operator' (thus, losing control), because they are – at an ostensible level of the discussion - considered to be the cause of errors … (although the opposite is true in many cases).*


* Streitz (2017) Reconciling Humans and Technology: The Role of Ambient Intelligence. Keynote Paper. *Proceedings of the 2017 European Conference on Ambient Intelligence*. Springer, LNCS 10217. pp. 1-16.
* Streitz (2019). Beyond 'Smart-Only' Cities: Redefining the 'Smart Everything' Paradigm. *Journal of Ambient Intelligence and Humanized Computing*. vol. 10, no. 2, pp. 791-812. Springer.

# Example:
# Problems with Sensors and ML in Automated Driving

- False recognition and its legal implications
  - Example: Speed Limit Info system in current cars does not reliably recognize time restrictions and provides the driver with wrong information (although this is very simple pattern recognition)
  - Human drivers can mentally correct wrong information, but how about the car sending wrong info ("*driver drives too fast*") to car insurance and the police? => legal implications !



- Physical Hacking: "scam stickers" cause ML to fail
  - Minimal modifications on signs or objects (no problem for human recognition) disturb 'deep learning' so much, that it produces very wrong results (STOP => 45 mph)
    (Study of the Univ. of Michigan, Univ. of Washington, Univ. of California, Berkeley, Samsung Research America and Stony Brook University)
  - ML in picture recognition: only details, no form or global view
  - There is no appropriate way to prevent physical hacking.


# Need to Redefine the ‘Smart-Everything’ Paradigm

- The trend of automating everything based on AI/ ML should be a warning sign due to many problems:
- **Inappropriate, insufficient, error-prone behavior**
- **Rigidity, wrong information, fake facts/ news**
  (Performance vs. Competence, “hallucinations” of ChatGPT, because no knowledge base in ML)
- **Missing transparency, traceability, and accountability**
  No transparency and intelligibility of underlying models in ML. Problem of “bias” in test data.
  Quote by ML researcher: “*We can build these models, but we don’t know how they work*.”
  *=> Need for Human-Centered AI and Explainable AI*
- **Principal and Ethical Issues**

**Conclusion:** We are confronted with new, more crucial dependency implications beyond the already existing severe dependencies on electricity (‘black-outs’) and on “standard” software/ hardware due to their intrinsic failures and their volatility in terms of cyber attacks
*=> we are losing more and more the control*

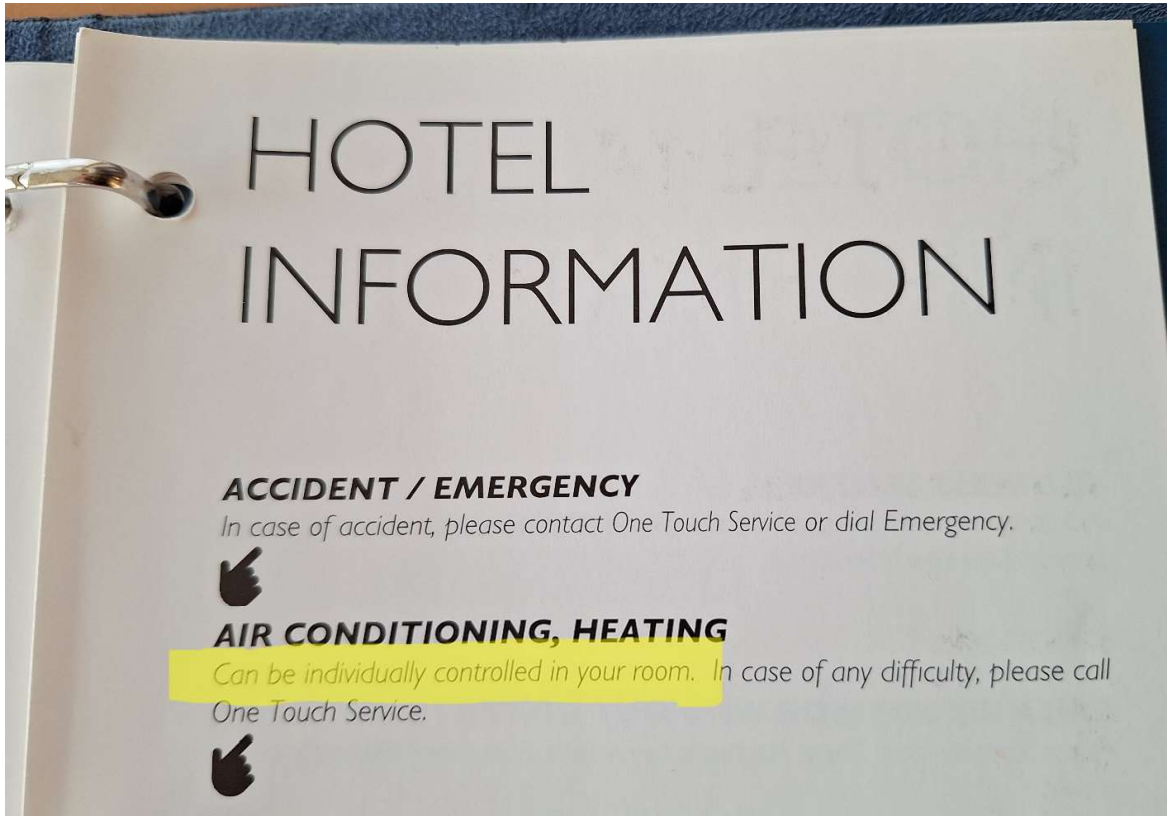
# Redefining the „Smart-Everything“ Paradigm

We have to address two major issues:

- First Design trade-off
  ***Empowerment of Humans by Keeping them in the Loop and in Control***,
  *even better: Humans should own the Loop*
  vs. ***Automated / Autonomous Systems***

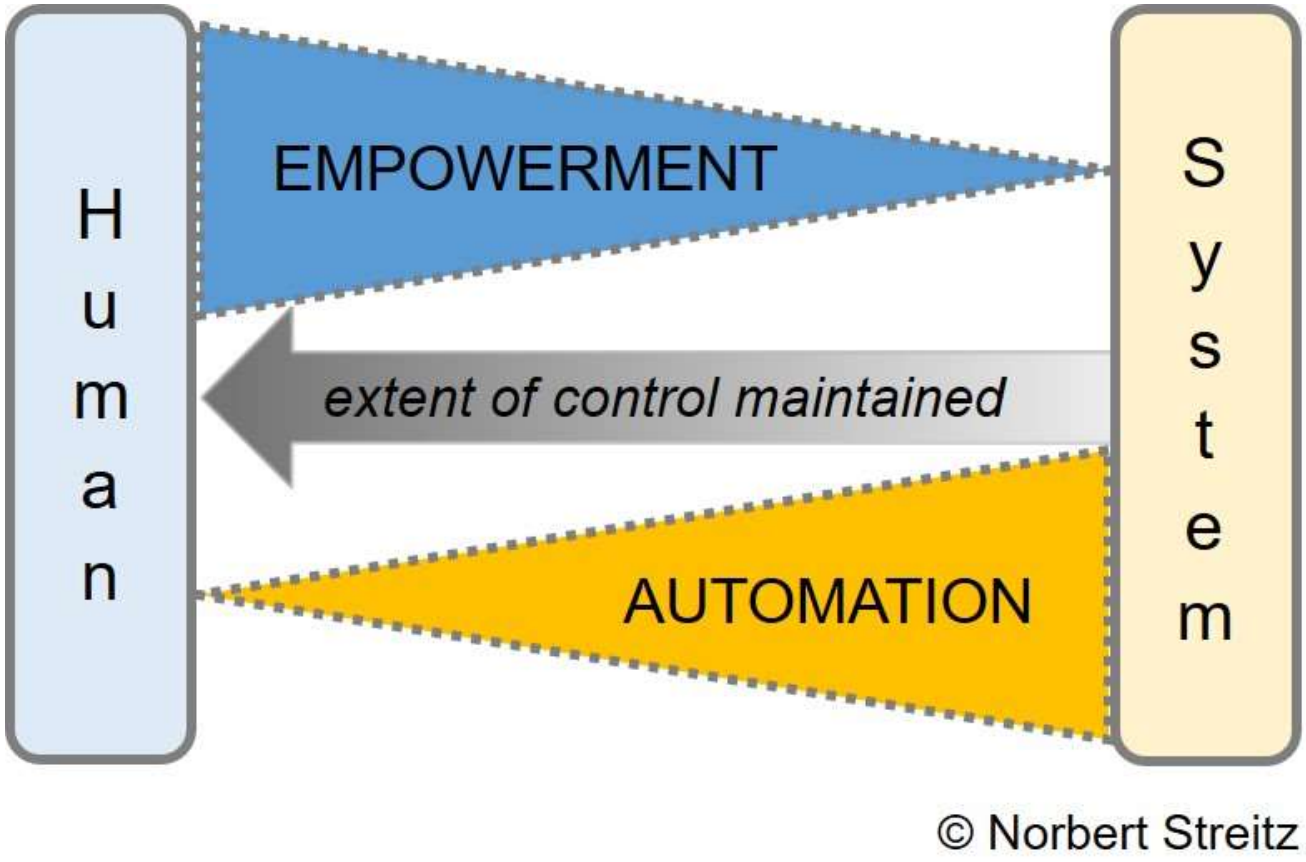
- Second Design trade-off
  ***User-defined and controlled Privacy-by-Design***
  vs. ***Importunate Smartness***

# Example of Importunate Automation

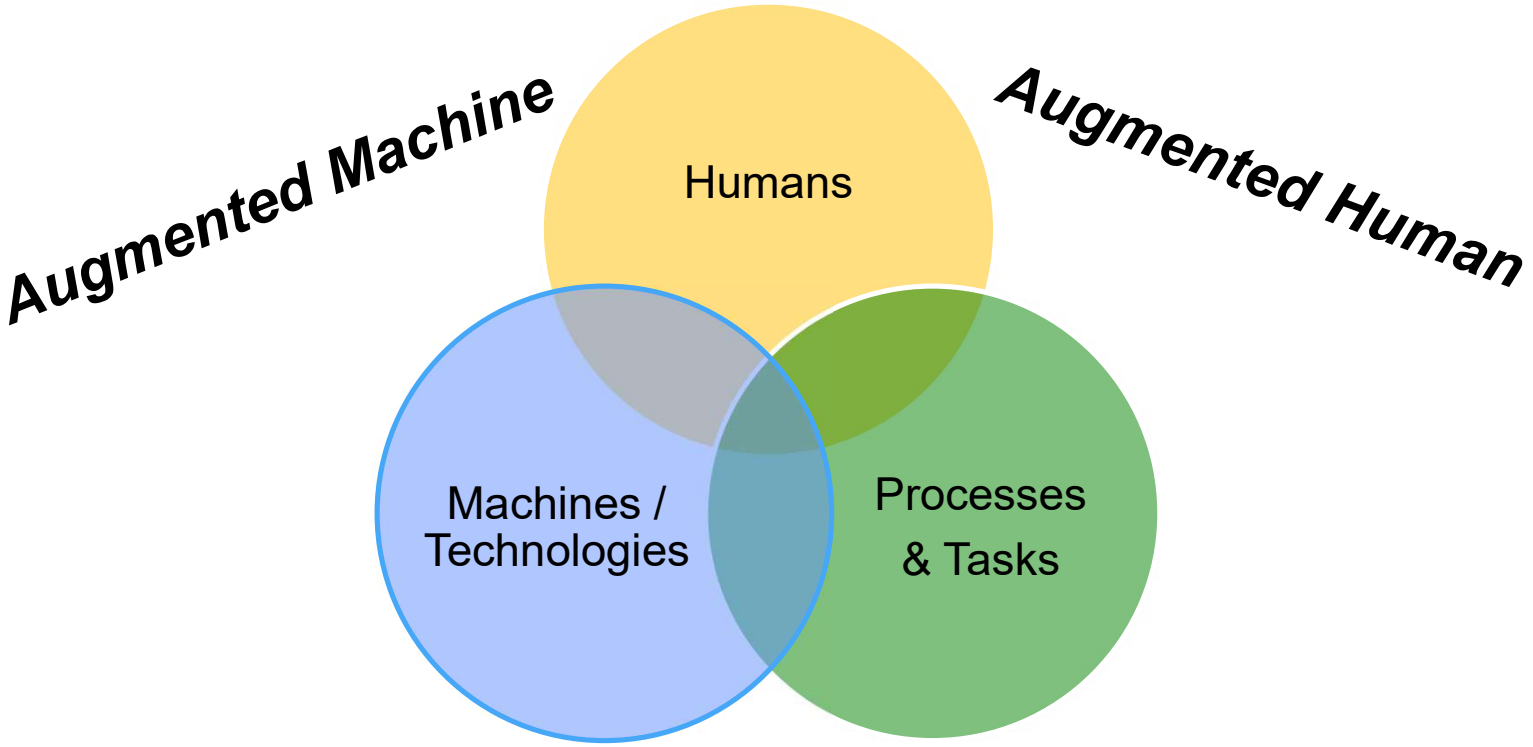

*Hotel guests can not individually turn off the air condition in their room.*
*Only hotel administration people are able to do this at the reception,*
*It is a centralized feature that determines how cold/warm it is in the room …*

# 1. Trade-Off: Human Control/Empowerment vs. Automation



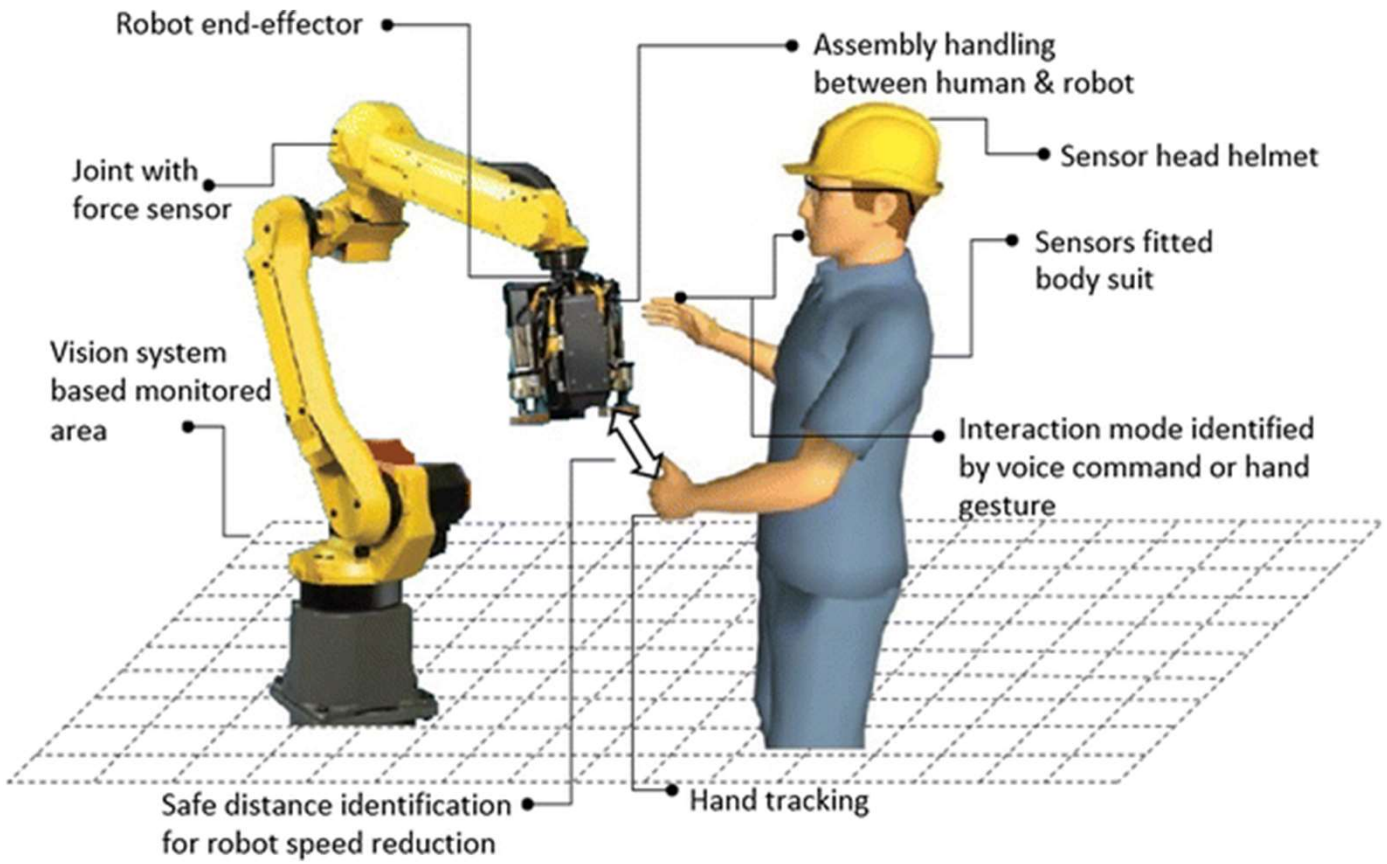

Design trade-off between human empowerment and importunate system automation depending on the extent of human control maintained

# Towards Mixed Intelligence and Balanced Automation




We should **take the best of both worlds (capabilities)** and combine them in an integrated fashion for **mutual augmentation**. Automation should be considered as a tool, resource, method for enabling humans to accomplish tasks that are otherwise difficult or impossible. (e.g., exoskeletons, fly-by-wire/auto-pilot airplanes, human-vehicle cooperation, …)

# Balanced Automation: Collaborative Robots

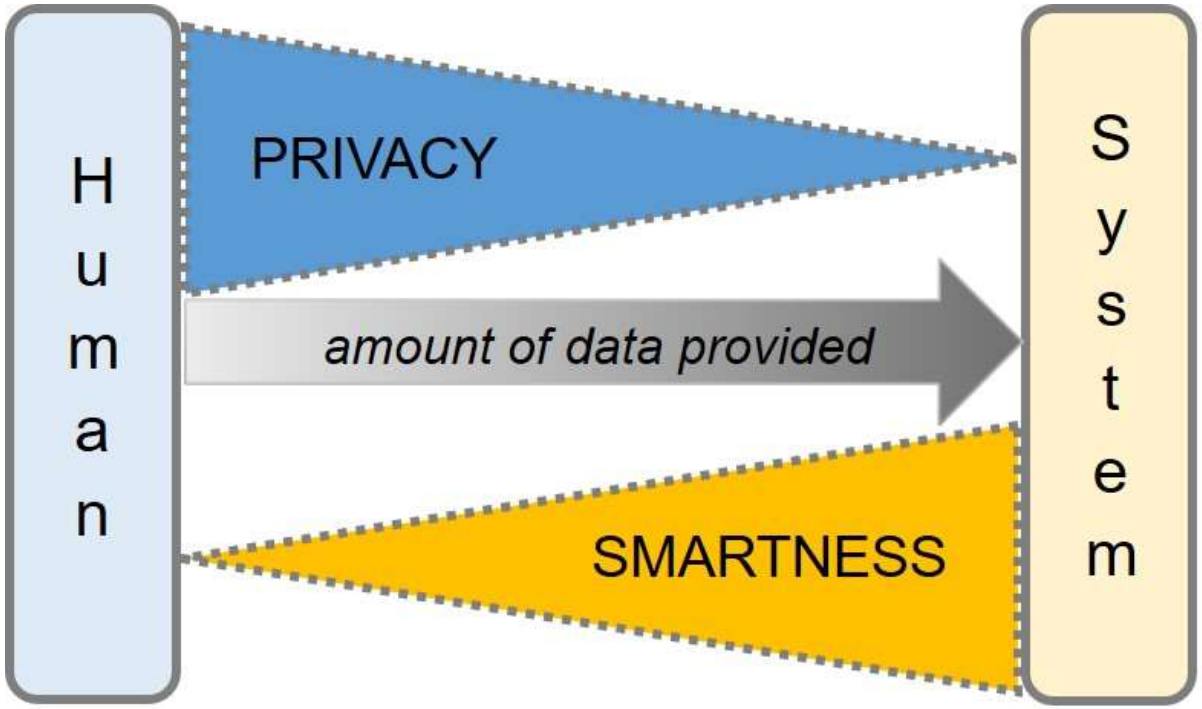



Human-Robot Teaming

Human-AI Teaming

Collaborative Robots are growing in popularity. They work safely alongside humans and are often cheaper compared with their industrial counterparts. As **Collaborative robots (Cobots)** become more capable in industrial settings, they get greater adoption by manufacturers. Collaborative Robots (Cobots) are complementing and not replacing human workers.

# 2. Trade-Off: User-defined Privacy vs. Importunate Smartness




© Norbert Streitz

Design trade-off between extent of privacy by being in control over personal data vs. degree of smartness provided by a smart system or service. Tricky trade-off, because a system can be smarter the more data it has available. People should control the trade-off between the benefits received and the data provided.

**Privacy infringements become increasingly important in real / urban "smart" environments => Hybrid Environments**

# Privacy by Design combined with Regulations

- Privacy-by-Design / Privacy-by-Default:
  making privacy a first-order design objective (not a subsequent add-on)
  by employing Privacy Enhancing Technology (PET)
- Privacy-by-Design as a competitive advantage (USP)

- *Regulations to prevent Privacy Infringements*
  - Germany (since 1983): "Recht auf informationelle Selbstbestimmung"
    Personal data belong to the citizens and cannot be collected without consent.
  - European Union
    - General Data Protection Regulation (GDPR www.eugdpr.org) since 2018.
      everybody who wants to do business in Europe must obey these rules !
    - e-Privacy Directive – several exceptions (derogations) under discussion
  - Japan
    - Act on the Protection of Personal Information (APPI) new version since 1. April 2022.
    - Personal Information Protection Commission (PPC)

# Towards Transparent, Reliable, Accountable, Trustworthy AI

- Europe
  - European Commission published *Ethical Guidelines for Trustworthy AI* (2019)
  - new rules for excellence and trust in Artificial Intelligence (EC 21. April 2021)
    … "*trust is a must, not a nice to have*" …
  - The *Artificial Intelligence Act (AI Act)* is an EU regulation on Artificial Intelligence (AI), passed on 13. March 2024.It establishes a common regulatory/legal framework for AI.
- Japan
  - *AI Ready Society* - Essential social revolution to achieve Society 5.0
  - *Social Principles of Human-centric AI*:
    i) Human-centric, (ii) Education, (iii) Privacy, (iv) Security, (v) Fair Competition, (vi) Fairness, Accountability, and Transparency, and (vii) Innovation.
- USA
  - Blueprint for an *AI Bill of Rights: A Vision for Protecting Our Civil Rights in the Algorithmic Age* (White House, 4. October 2022)
    Five Common Sense Protections:
    1) Safe and Effective Systems 2) Algorithmic Discrimination Protections 3) Data Privacy 4) Notice and Explanation 5) Human Alternatives, Consideration, and Fallback
- The task is to fill these guidelines with life and make them real !

# Privacy and Security as a USP

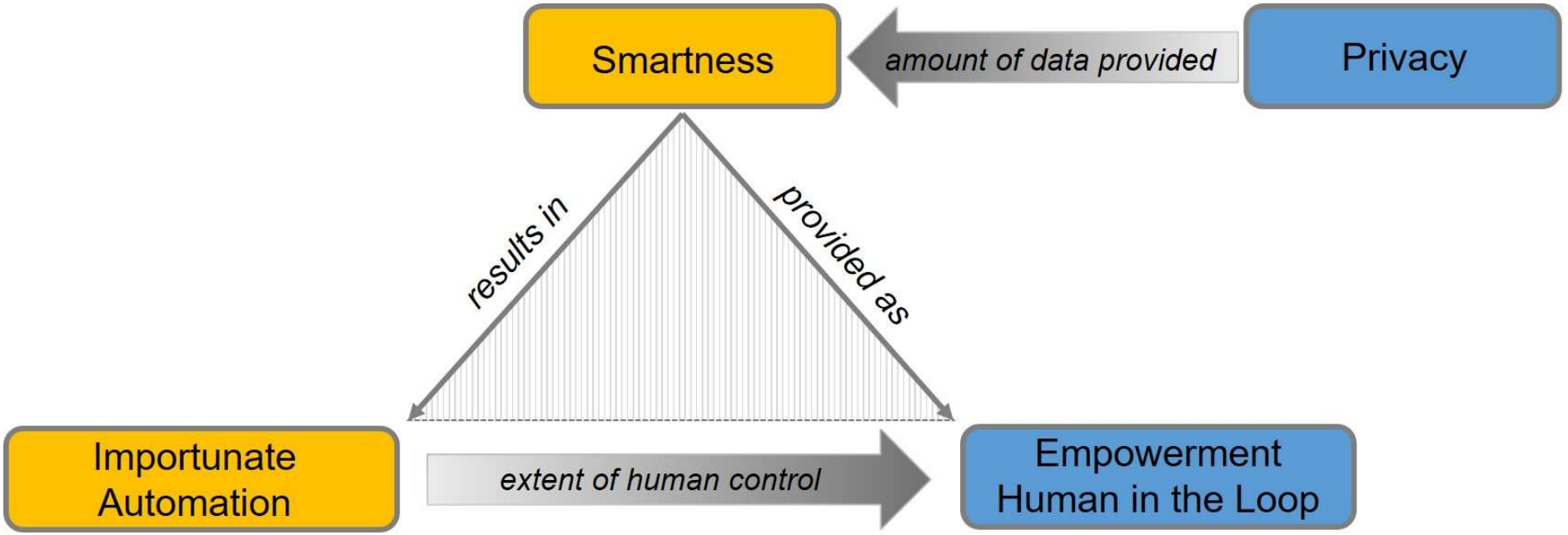
- Moving everything to the “Cloud”
  causes severe security and privacy problems ...
- **Example of Iceland**
  Following the financial & economic crisis, Iceland developed a *new business model* in terms of sustainable, secure data centers / server farms:

1) perfect cool weather conditions
2) cheap and clean energy (geothermal, hydroelectric)
3) safe and secure physical facilities for servers
4) separate secure sea link cable between Iceland and Denmark
5) introduction of privacy-conform legislation Iceland’s Data Protection Act / now also GDPR

(Examples of clients: BMW, DeepL, block chain companies, …)

- *Privacy and Security will turn into a USP, providing added value, resulting in opportunities for European companies.*

# Combination of Design Trade-offs




The two design trade-offs are not independent: Their combination indicates the appropriate provision of smartness provided by a balance of assisting partial automation support as well as human control (including privacy) and empowerment at the same time.

Streitz (2019). Beyond 'Smart-Only' Cities: Redefining the 'Smart Everything' Paradigm. *Journal of Ambient Intelligence and Humanized Computing*. vol. 10, no. 2, pp. 791-812. Springer.

# Smart Cities as ‚Self-Aware' Cities

- IoT infrastructures provide multiple sources of information via sensors, actions and feedback via actuators and thus the basis for a "*Self-Aware* City".
- *Smartness of a City* can be characterized by *how much the city knows about itself* (=> *Self-Awareness*) and how the information is communicated to the city administration and to citizens to make them smarter.
- The more information exists about situations and conditions, the more people can make informed decisions (=> appropriate solutions for open problems).

- *Urban Sustainability*

  Increasing populations and urbanization require innovative ways to address urbanization with minimal impact on environment, citizen lifestyles, governance. Self-Aware Cities can address these issues.

# Smart Spaces Make People Smarter

- People will have more information once (urban) spaces are "self-aware smart", i.e., instrumented and providing a first analysis.
- Humans can exploit sensor-generated data to take more mature, i.e., informed decisions and actions.

- In the redefined paradigm, "smart (urban) spaces" do not act autonomously, but function like companions, supporting people in a cooperative fashion.

  => ***the smart space is a cooperative space and makes people smarter !***

- This paradigm shift requires that
  - ***humans are in the loop and in control***
  - ***humans should own the loop***

Streitz (2019). Beyond 'Smart-Only' Cities: Redefining the 'Smart Everything' Paradigm. *Journal of Ambient Intelligence and Humanized Computing*. vol. 10, no. 2, pp. 791-812.

# Self-Awareness: Measuring Train Congestion (Tokyo)

Congestions in subways - and trains in general - is a big problem, but difficult to measure (counting people?)

*Approach*:

Sensors are measuring the level of $CO_2$ in train compartments which is used as a model-based indicator for the level of congestion.

*The more $CO_2$ => the more people*.

Results on congestion are posted on train network maps, etc. informing citizens, allowing them to make better informed decisions.

Konomi, S., Shoji, K., Ohno, W. (2013). Rapid development of civic computing services: Opportunities and challenges. In: N. Streitz, C. Stephanidis (Eds.), *Distributed, Ambient, and Pervasive Interactions.* LNCS 8028. Springer. pp. 309–315

# Privacy and Urban Spies in Smart City Scenarios

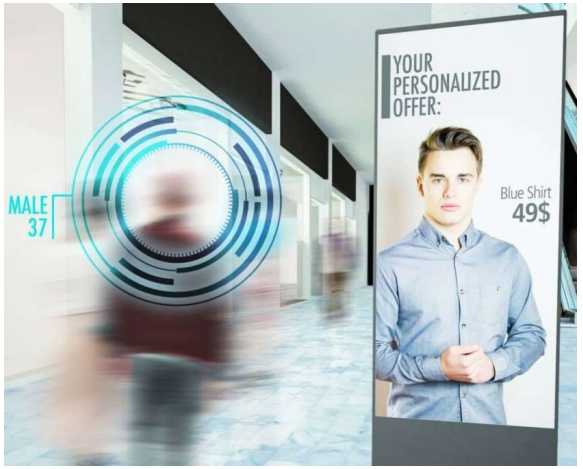
- **Principal Problem:**
  how do people know what is going on?
  Technology is integrated into the environment and invisible.

- Experimental **Smart Cars** show visible sensors for automated driving (cameras, ultrasonic sensors, radar, LIDAR, …),
  but now we are not able to notice sensors and capabilities!

- Will these sensors go asleep when the car parks at the curb and the engine is turned off? We can not be sure !
- Berlin: Police authorities issued access prohibitions for Tesla cars due to “event-independent” recording with eight external cameras (“Sentry” Watch-Mode); remote access view possible.

- **Digital out of Home (DOOH) Advertising Displays** applying face analysis, behavior detection, etc. for personalized ads, …
  => personal data are collected without consent.

- *Who owns, has control, access to all these data?*



# Beyond ‘Smart-Only’ Cities towards Humane, Sociable and ‘*Cooperative*’ Cities


**=> Enabling citizens to exploit their individual, creative, social and economic potential and to live a self-determined life.**

# Citizens in the Loop: Co-Provision, Co-Creation, and Co-Exploration

- Participatory Design
  - motivating citizens to get engaged, be part of the urban community and contributing to the public good and welfare
  - inclusion and participation enables citizens to obtain a more comprehensive and augmented perspective

- Open Data Model
  - having a mutual "city ⇔ citizen" exchange and transparent use rights of data, motivates them to actively contribute data to the city authorities and at the same time motivating them to allow data collection and monitoring.
  - co-provision, co-creation, and co-exploration creates the basis for a "win-win" situation for all stakeholders.
  - provides the basis for the "*Citizen ⇔ Cooperative City Contract*".

Norbert A. Streitz (2021). From Smart-Only Cities towards Humane and Cooperative Hybrid Cities. *Technology* | *Architecture* + *Design*. Vol. 5, Issue 2 (Special Issue on Intelligence). pp. 127 - 133.

Norbert A. Streitz, Christine Riedmann-Streitz (2022). Rethinking 'Smart' Islands towards Humane, Self-Aware, and Cooperative Hybrid Islands. *Interactions*. May-June Issue 2022. pp. 54 - 60. ACM Press.

# *Citizen ⇔ Cooperative City Contract*

- **Third**: *Establishing a dynamic* ***Citizen ⇔ Cooperative City Contract (CCCC or C⁴)*** *for negotiating the trade-offs*

  - *Human control and empowerment vs. importunate automation*
  - *Privacy-by-design vs. importunate smartness as the basis for data exploitation (e.g., open data model)*

  - CCCC will be based on rules and regulations that organize the relationships between the different stakeholders in a city: citizens, city administration, service providers and other city-related companies

  - allowing for participatory design, co-creation, co-provision and co-exploitation
  - some regulations can be based on the GDPR of the EU (since May 2018!)
  - marketplaces for trading digital data are emerging (data sharing economy)
  - The Zero Dollar Car (John Ellis, former head of technology at Ford)

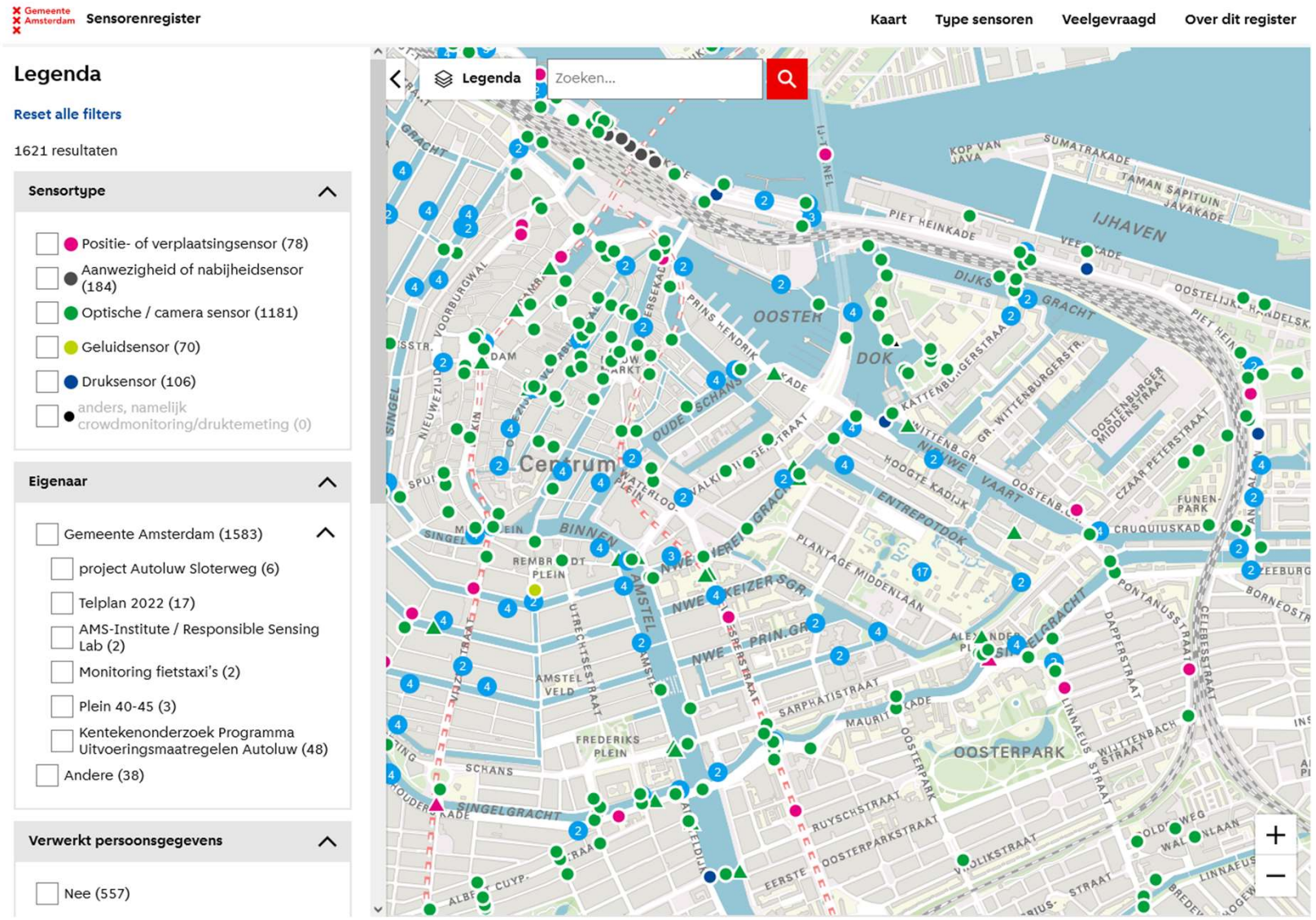
  - Implementation proposal: ‚smart contracts' using a block chain approach

# Respecting the Rights of Citizens and their Privacy

- Co-Provision, Co-Creation, and Co-Exploration works only if the rights of citizens and their privacy are being respected in all phases.
- Privacy, self-determination of data, transparency are increasingly relevant for activities in public urban spaces (actually hybrid environments). Combination of surveillance and data exploitation ("data shadows" of people) (=> *urban spies*).

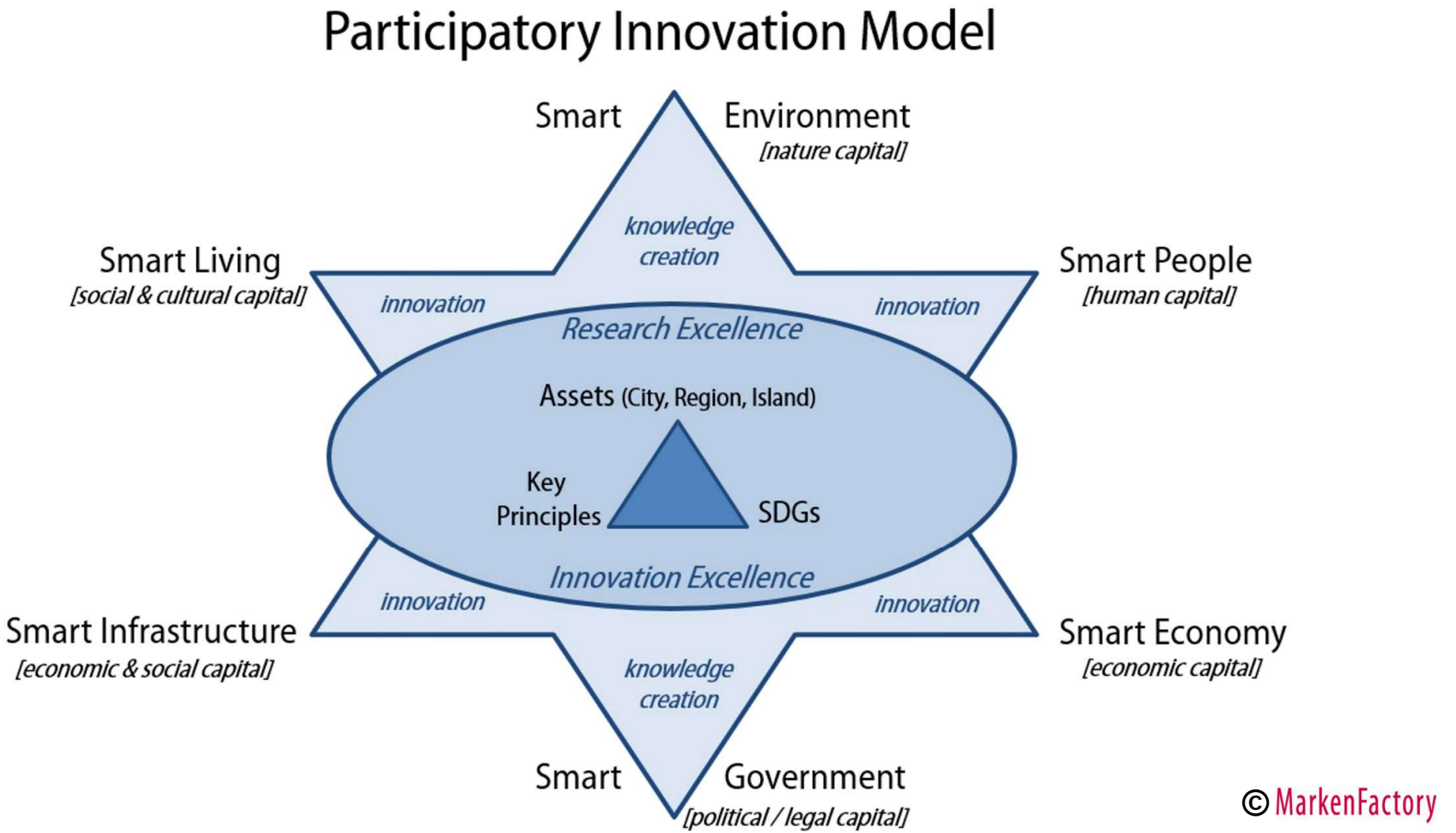
(Credit: Ryoji Iwata, Unsplash)

# Amsterdam Introduces Mandatory Register for Sensors

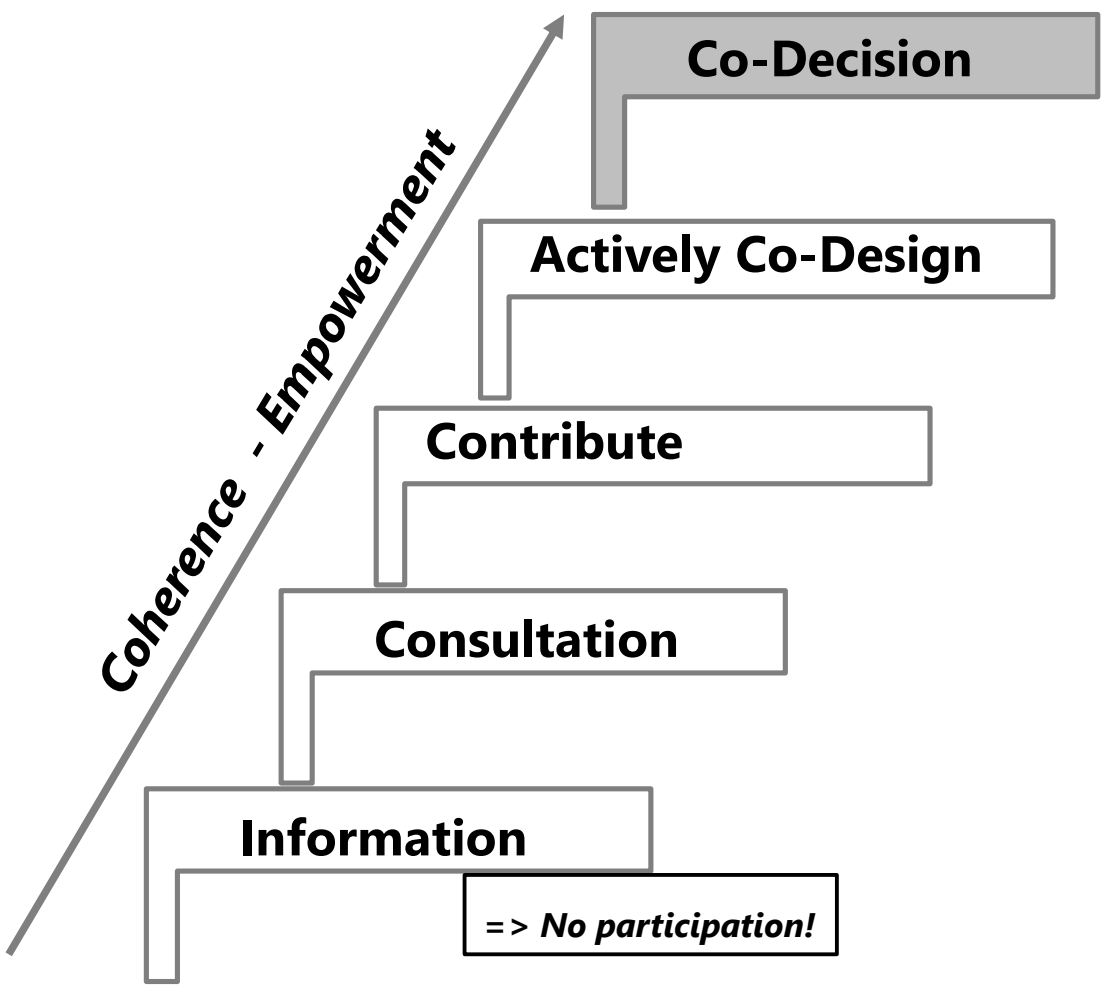



… in addition, there is a movement *Watching the Watchers* via citizen websites (The Netherlands)

# Participatory Design for Smart Environments



# Participatory Levels of Different Formats




***Contribute & share knowledge & competencies for the best decisions & solutions, which are jointly supported, accounted for, and communicated by many (diversity!).***

- ⇨ ***Broad acceptance***
- ⇨ ***Broad commitment***
- ⇨ ***Ownership***
- ⇨ ***Satisfaction:***
  - ***be part of a greater whole***
  - ***be part of success***

# Design Café Approach (Madeira 2021, Crete 2022, Copenhagen 2023)

**Design Café is a very interactive participatory workshop**
(lasting about 1 day or ½ day) based on proven methods and principles:

- *Urgency/Relevance*: addressing a relevant purpose with personal significance for the participants ("what's in for me"; new ideas for their own work, etc.).
- *Voluntary*: Participation is voluntary. They decide to which topics they contribute.
- *Diversity*: Emphasis on interdisciplinarity, multiculturalism, multi-generations – basis for diversity of perspectives.
- *Positive Emotions*: Providing a relaxed café atmosphere.
- *Rules of the Game*: Define and communicate the rules. Every idea is welcome. No idea is prematurely evaluated and criticized.
- *Moderation*: The moderator actively involves everybody, promotes mutual exchange and creativity, and structures the different phases.
- *Commitment*: Clear statement about how the results will be used.

References:

N. Streitz, C. Riedmann-Streitz (2022). Rethinking 'Smart' islands towards humane, self-aware, and cooperative hybrid islands. *Interactions,* 29(3), pp. 54–60. https://doi.org/10.1145/3527200

N. Streitz, C. Riedmann-Streitz, L. Quintal (2022). From 'smart-only' island towards lighthouse of research and innovation. *Proceedings of the 10. International Conference on Distributed, Ambient and Pervasive Interactions: Smart Environments, Ecosystems, and Cities. (DAPI 2022).* Springer LNCS 13325. pp. 105–126.

# Design Café at HCI International 2023, Copenhagen.

- Highly interactive participatory workshop motivated by the ubiquitous challenges our world is facing, we explored six main issues from an interdisciplinary perspective with the focus on
  - UN SDG 11: "Sustainable Cities and Communities" and
  - HCI Grand Challenge 2 "Human-Environment Interactions."
- The six issues are:
  - 1. How to create inclusive and ethical smart cities?
  - 2. How to establish trust between people and smart environments?
  - 3. How to address privacy concerns in smart environments that adopt the “disappearing computer” paradigm?
  - 4. How to promote explainability and transparency of policies and measures to citizens of smart cities?
  - 5. How to design incentives and rewards for engagement and sustainable behavior in smart cities?
  - 6. How to measure success and impact in sustainable smart city projects?

***NEW:*** C. Riedmann-Streitz, N. Streitz, M. Antona, A. Marcus, G. Margetis, S. Ntoa, P. Rau, E. Rosenzweig (March2024). How to Create and Foster Sustainable Smart Cities? Insights on Ethics, Trust, Privacy, Transparency, Incentives, and Success. *International Journal of Human-Computer Interaction.* https://doi.org/10.1080/10447318.2024.2325175

# Design Café at HCI International 2023, Copenhagen.


***They are also main issues for Human-AI Teaming***

# Summary

1) *Current and future environments, cities and their infrastructures are increasingly dependent on information/communication technology (Internet of Things, Artificial Intelligence, Machine Learning, …).*

2) *The more the "computer" disappears and becomes invisible, the more it obscures transparency and determines our lives.*

3) *Problem: danger of a primarily technology-driven development with unforeseen implications with respect to automation, loss of human control, privacy and security.*
*The "technology first" approach results in less acceptance and missing trust in "smart" environments/ cities offered to citizens.*

4) *Proposal: Instead of AI first: Humans First => Humanity-Centered Design, respecting the preferences and needs of people/ citizens: Beyond "smart-only" towards Humane, Sociable, Cooperative Cities.*

5) *An approach based on privacy-by-design and trustworthy AI assures added values, benefits, acceptance => USP for European industry.*

**Future Cities / ‘smart’ Environments are *Hybrid***

and should be

***Cooperative and Humane***

being designed based on a

***Citizen-/Humanity-Centered Approach.***