The Creeping Disempowerment of Users in the Digital Transformation

and Its Connection to (Un-)Sustainable Development

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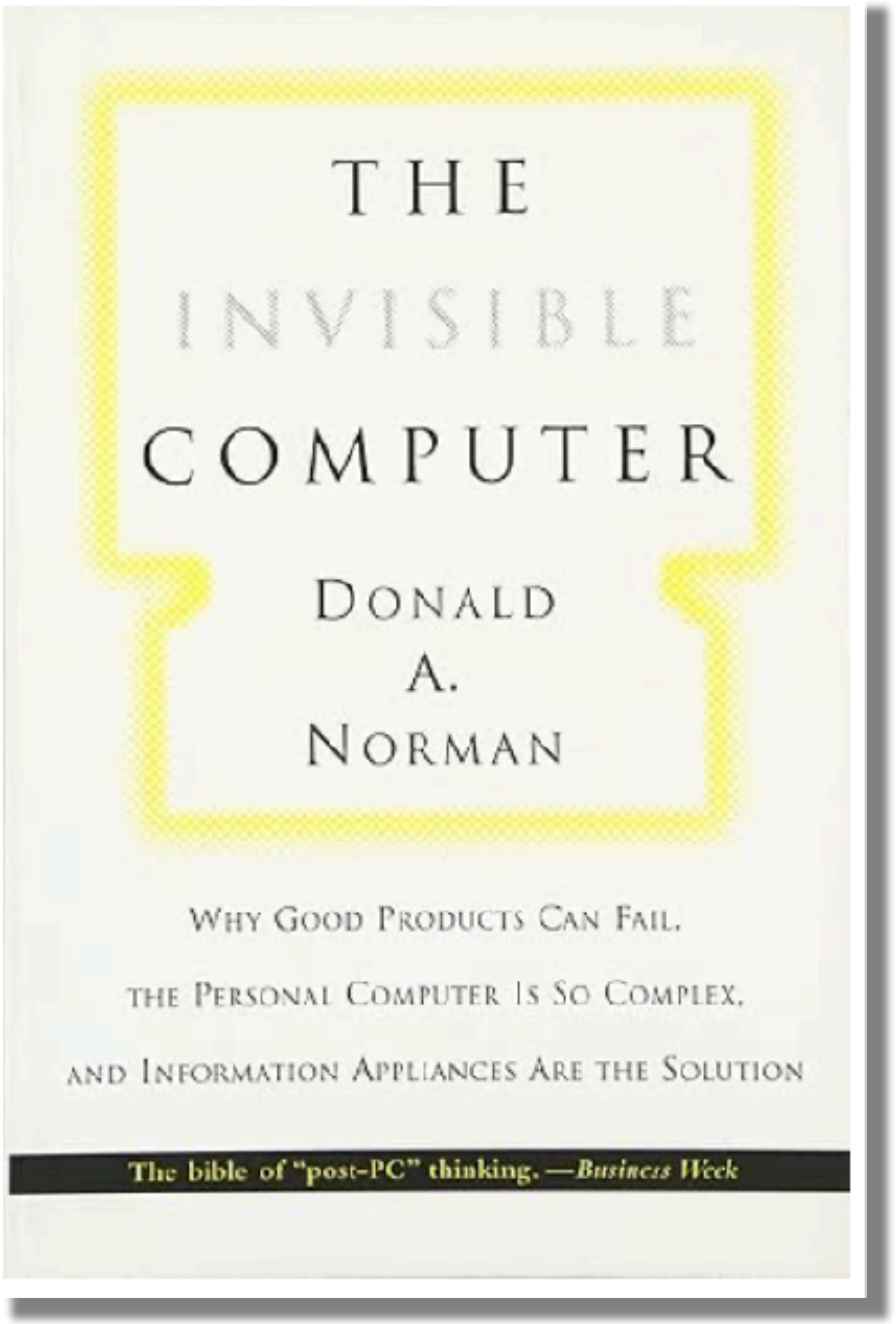
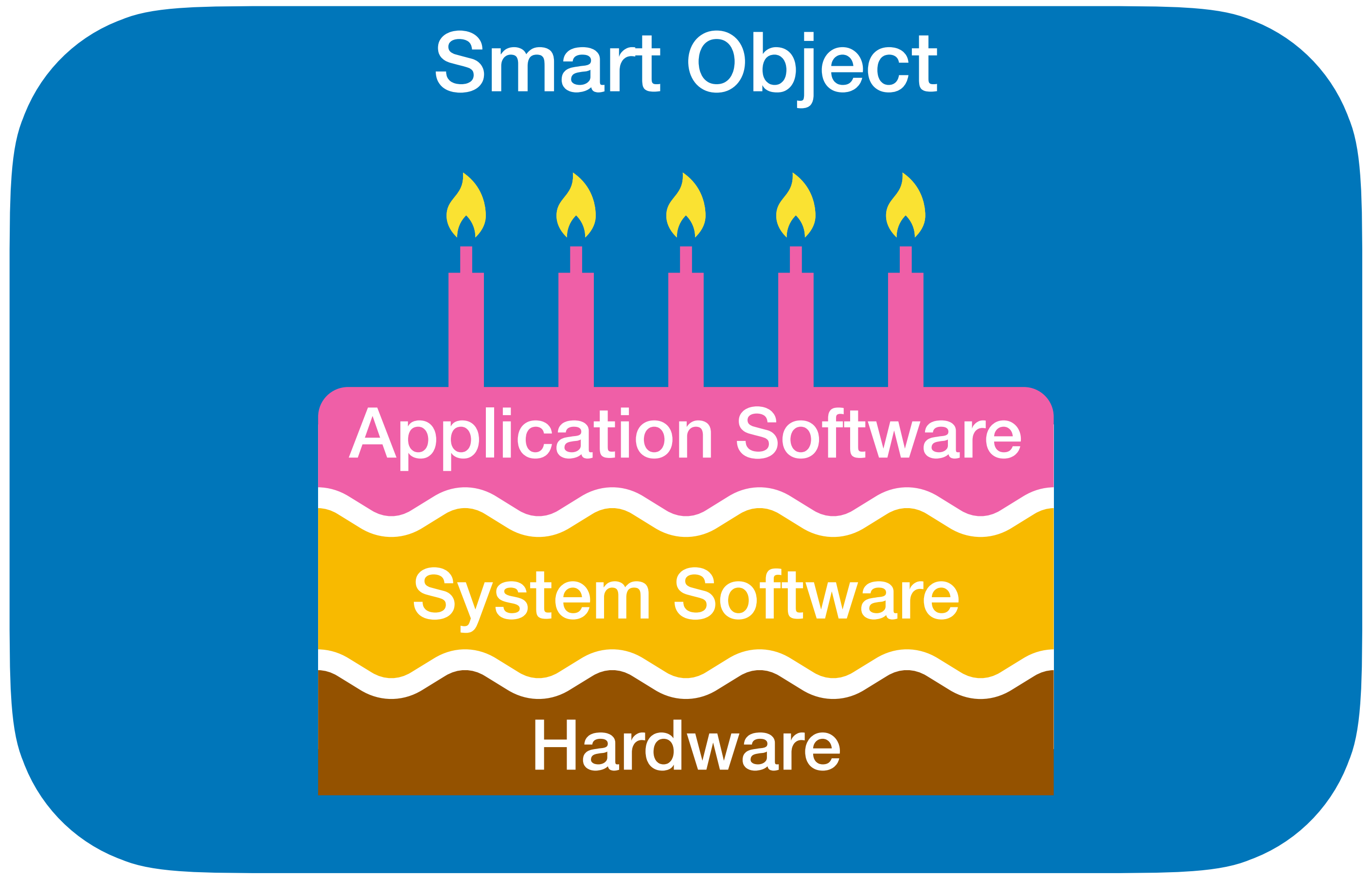


Donald Norman's visionary idea, published in 1998



Computer embedded in an object not perceived as a computer

Smartphone
Smartwatch
Smartcard
Smart TV
Smart glasses
Smart container

Fitnesstracker
E-book-reader
Dishwasher
Car
…


Earth System Context: Air, Water, Food, Energy and Material Resources, Stable Climate, …
Socio-Economic Context: How Society is Organised, Produces and Consumes
Socio-Technical Context: Users and Use Cases, Purpose
Smart Object
Application Software
System Software
Hardware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Smart Object
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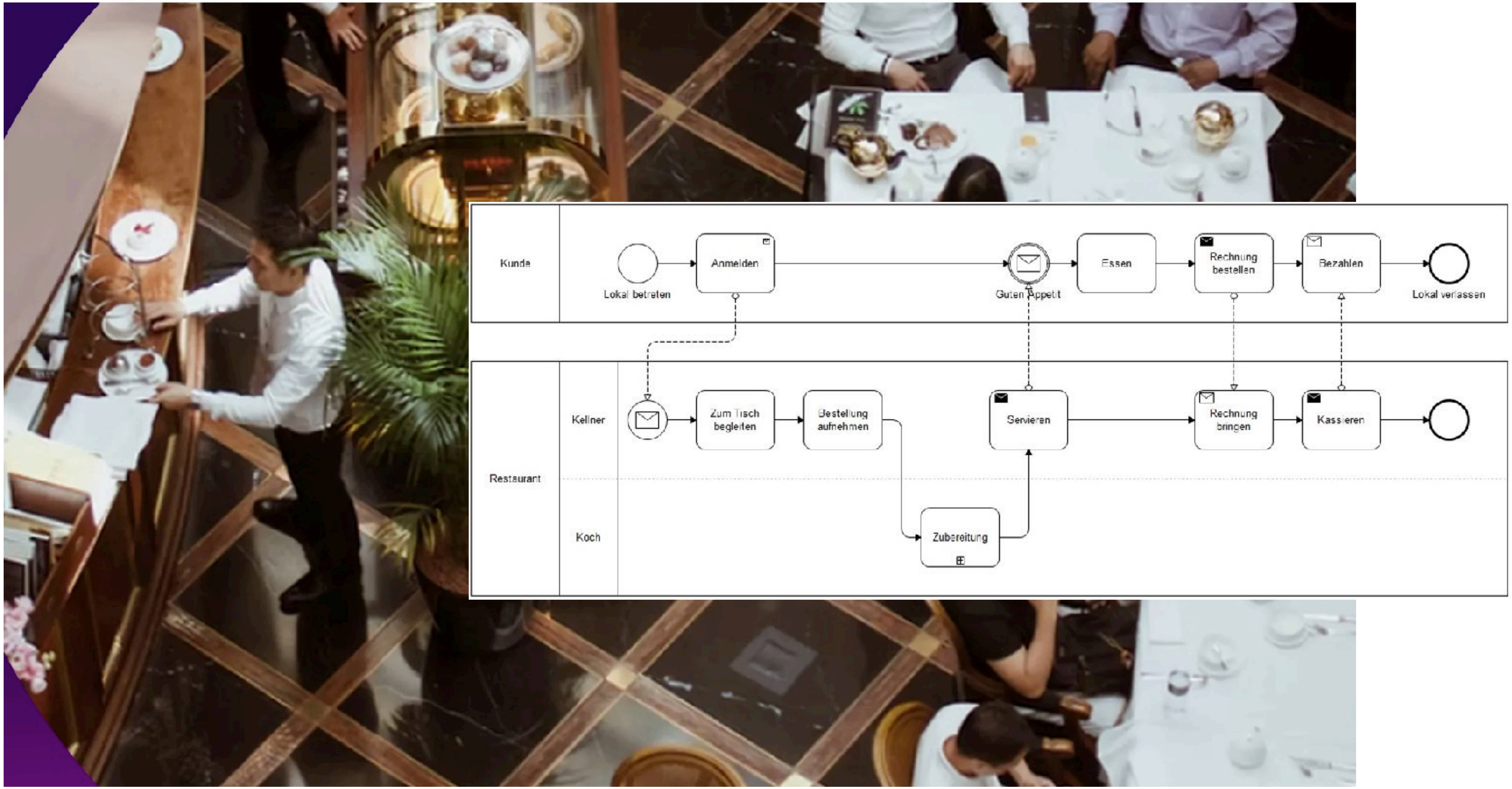
System Software
Hardware
Sustainablity in Digitalisation
(digital solutions adapt to changing contexts)
Sustainability by Digitalization
(digital solutions contribute to sustainable development)
Green IT/ICT
(from software to hardware to planet)

Example: Business Process Modelling



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1. The Basic Idea of "Handprint" and "Footprint"

Handprint

Desired effects on sustainability through "enabling effects", e.g. optimization of processes, transport of data instead of tangible items, easier access to information and knowledge.

(Method used: comparison of scenarios)

10% energy saving through driving assistance system

Footprint

Accepted consequences of the production, operation and disposal of digital devices and infrastructures, e.g. emissions, raw material consumption, working conditions in the supply chains, generation of electronic waste

(Methods used: Life Cycle Assessment, LCA, or Input-Output Analysis)

2. Carbon Handprint/Footprint as a Special Case, “small” Examples

	E-book reader	**Smart home** (5 years)	**Videoconference Zurich – New York**	**1 query to ChatGPT**	**1 Bitcoin transaction**
Handprint	**1.3/book** kg CO_2e	**1250** kg CO_2e	**3369/roundtrip** kg CO_2e	**?**	**?**
Footprint	**42** kg CO_2e	**869** kg CO_2e	**0.29/h** kg CO_2e	**0.0043** kg CO_2e	**402** kg CO_2e
	Moberg et al. (2011)	Pohl et al. (2021)	Warland et al. (2016)	smartly.ai (2024)	Trespelacios & Dijk (2021)

3. Carbon Handprint/Footprint as a Special Case, “big” Examples (1/3)

Review of **prospective studies** of the footprint and handprint of ICT (vulgo digital technologies) at **national or global level** (Bieser et al., 2023).

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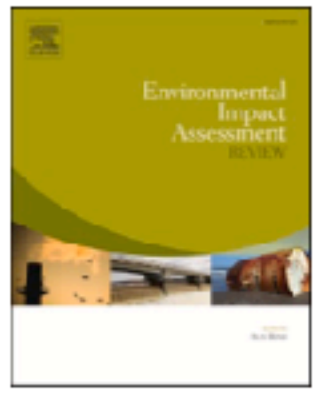

A review of assessments of the greenhouse gas footprint and abatement potential of information and communication technology

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ABSTRACT

Various studies have assessed the GHG footprint of the ICT sector (ICT end-user devices, data centers, telecommunication networks) and the potential of ICT use cases (e.g. smart homes, ride sharing) to avoid GHG emissions in other sectors (e.g buildings, transport). We systematically compare relevant studies from the last ten years and discuss the robustness of results in view of the methods used. The results show that the ICT sector causes between 1.5% and 4% of global GHG emissions, a major share of which is due to the production of ICT end-user devices. Estimating GHG impacts of device production is the main source of uncertainty. Results of studies on ICT's GHG abatement potential are less robust, in particular due to uncertainty with regard to use case impacts in a real-life setting, types and sizes of economy-wide rebound effects. Thus the existing studies do not provide a reliable basis for estimating the actually realized GHG abatements. To improve the assessment results and provide a more reliable basis for deriving GHG reduction measures future research should empirically investigate which solution design and accompanying policies are suitable to exploit GHG reduction potentials in real-life. Results of these studies would also increase the robustness of assessments of GHG abatement potentials.

3. Carbon Handprint/Footprint as a Special Case, “big” Examples (2/3)

GHG abatement levers by sector.

Sector	GHG abatement levers
Electricity and heat	- Promotion of energy-saving behavior through measurement and display of energy consumption (“energy meters) - Flexibilization of electricity demand and coupling of flexible demand with availability of electricity from management”) to increase the share of renewable energies in electricity consumption - Reduction of transmission losses (e.g., through optimized electricity distribution)
Transport: virtual mobility	- Avoidance of commute through mobile work (e.g., teleworking from home) - Avoidance of business trips through virtual meetings (e.g., video conferences) - Reduction of shopping trips through e-commerce - Reduction of trips to banks through e-banking - Reduction of trips for education through e-learning - Reduction of trips to doctors through e-health
Transport: shared mobility	- Reduction in the number of vehicles and vehicle miles traveled through car sharing - Reduction in the number of vehicles and vehicle miles traveled through ride sharing (e.g., carpooling)
Transport: intelligent transport	- Avoidance of vehicle miles traveled through optimized route planning (e.g., through navigation systen - Intelligent traffic monitoring and control (e.g., by controlling traffic flow and avoiding congestions) - Increase in fuel efficiency through the use of digital technologies in vehicles (e.g., efficient engine mai - Improvement of transport system planning (e.g., through computer simulations) - Shift of choice of transportation modes from motorized individual transport to more GHG-efficient tra mobility platforms)
Transport: intelligent logistics	- Higher capacity utilization of vehicles and avoidance of vehicle miles traveled and empty trips throug - Shift from GHG-intensive to more GHG-efficient transport modes (e.g., through intermodal transport p - Predictive maintenance
Buildings	- Monitoring of energy consumption in buildings and increasing consumption transparency (e.g., for ide - Automated building control (e.g., adaptive heating and ventilation control) - Improvement of building planning (e.g., through computer simulations)
Industrial production	- Production process optimization (e.g., remote maintenance) - Increase in fuel efficiency of motors (e.g., efficient engine management) - Development of materials that cause fewer GHG emissions in production, use and disposal (e.g., throu
Agriculture	- Production process optimization in agriculture (e.g., through automation) - Improved monitoring and control of agricultural machines (e.g., controlled traffic farming) - Increase in productivity through monitoring of the health status of farm animals - Reduced emissions per animal through optimized feeding - Less use of fertilizers (e.g., precision fertilization by monitoring environmental factors in fields with se - Reduction of food waste and losses by increasing transparency along the value chain
Media	- Replacement of paper documents with digital documents (e.g., invoices, tax returns, newspapers) - Replacement of physical devices with virtual devices (e.g., answering machines) - Replacement of physical data carriers for audiovisual media with data storage in the cloud (e.g., distribution of music and movies via streaming platforms and not via CDs / DVDs).

Excerpt from abatement levers:

energy feedback systems

teleworking

videoconferencing

car sharing

traffic monitoring and control

intelligent logistics

process optimization

intelligent agriculture

reduction of food waste

replacing paper by electronic media

replacing data carriers by cloud storage

3. Carbon Handprint/Footprint as a Special Case, "big" Examples (3/3)

Overview of studies on the GHG abatement potential (absolute and relative share of total emissions in the observation year) of ICT, and enablement factors of considered studies.

Investigator/ authors	Commissioner/publisher	Year of publication	Geographic focus	Year of consideration	Number of use cases	GHG abatement potential [Mt CO_2e]		GHG abatement potential relative [%]		Enablement-factor	
						min	max	min	max	min	max
GeSI & McKinsey	GeSI, The Climate Group	2008	Global	2020	39	7800	7800	15.0%	15.0%	n. a.	5.5
GeSI & BCG	GeSI	2012	Global	2020	35	9100	9100	16.5%	16.5%	n. a.	7.2
WWF Canada	WWF Canada	2008	Canada	2020	9	19.1	36	n. a.	n. a.	19.1[a]	36[a]
Hilty & Bieser	Swisscom, WWF Switzerland, University of Zurich	2017	Switzerland	2025	10	0.72	6.99	n. a.	n. a.	0.26	3.37
Pamlin	WWF Sweden	2008	Global	2030	13	1168	8711	n. a.	n. a.	n. a.	n. a.
Malmodin & Bergmark	Ericsson	2015	Global	2030	17	4699[a]	9716[a]	7.4%	15.3%	n. a.	n. a.
GeSI & Accenture Strategy	GeSI	2015	Global	2030	12	12,080	12,080	20.0%	20.0%	n. a.	9.7
GeSI & Deloitte	GeSI	2019	Global	2030	7	668	3496[a]	1.3%[a]	8.9%[a]	0.7[a]	4.7[a]

[a] Own calculations based on figures provided in the study.

Huge differences in the results are not surprising, even for same (future) year and same region. By looking into the reasons for the differences, we can see what must be influenced to optimise the handprint/footprint of digitalization.

3. Carbon Handprint/Footprint as a Special Case, “big” Examples (extra)

Overview of studies on the global GHG footprint of the ICT sector (direct effects).

Investigator/authors	Title	Commissioner/ publisher	Year of publication	Year(s) of consideration	Spatial focus	GHG footprint [Mt CO_2e]	
						min	Max
Malmodin & Lundén	The Energy and Carbon Footprint of the Global ICT and E&M Sectors 2010–2015	Ericsson, Telia Company	2018	2010	Global	720	720
				2015		730	730
GeSI & BCG	SMARTer 2020	GeSI	2012	2020	Global	1270	1270
GeSI & Accenture Strategy	SMARTer 2030	GeSI	2015	2030	Global	1250	1250
GeSI & Deloitte	Digital with Purpose: Delivering a SMARTer 2030	GeSI	2019	2030	Global	741	903
Andrae & Edler	On Global Electricity Usage of Communication Technology: Trends to 2030	Huawei	2015	2020	Global	887	3634
				2030		1491	19,947
Belkhir & Elmeligi	Assessing ICT global emissions footprint: Trends to 2040 & recommendations	McMaster University	2018	2020	Global	1110	1310
				2030		2480	2620
				2040		5100	5300

4. Limitations of the “Handprint-Footprint”-Scheme

The blind spot of the handprint

- On the handprint side, there is a intrinsic bias towards *desirable* enabling effects. If the footprint is cost, the handprint is utility, and we usually don’t think of negative utility.
- However, all technical innovations can *enable* or even *require* actions that may be undesirable from a sustainability perspective (also called “induction effects”).

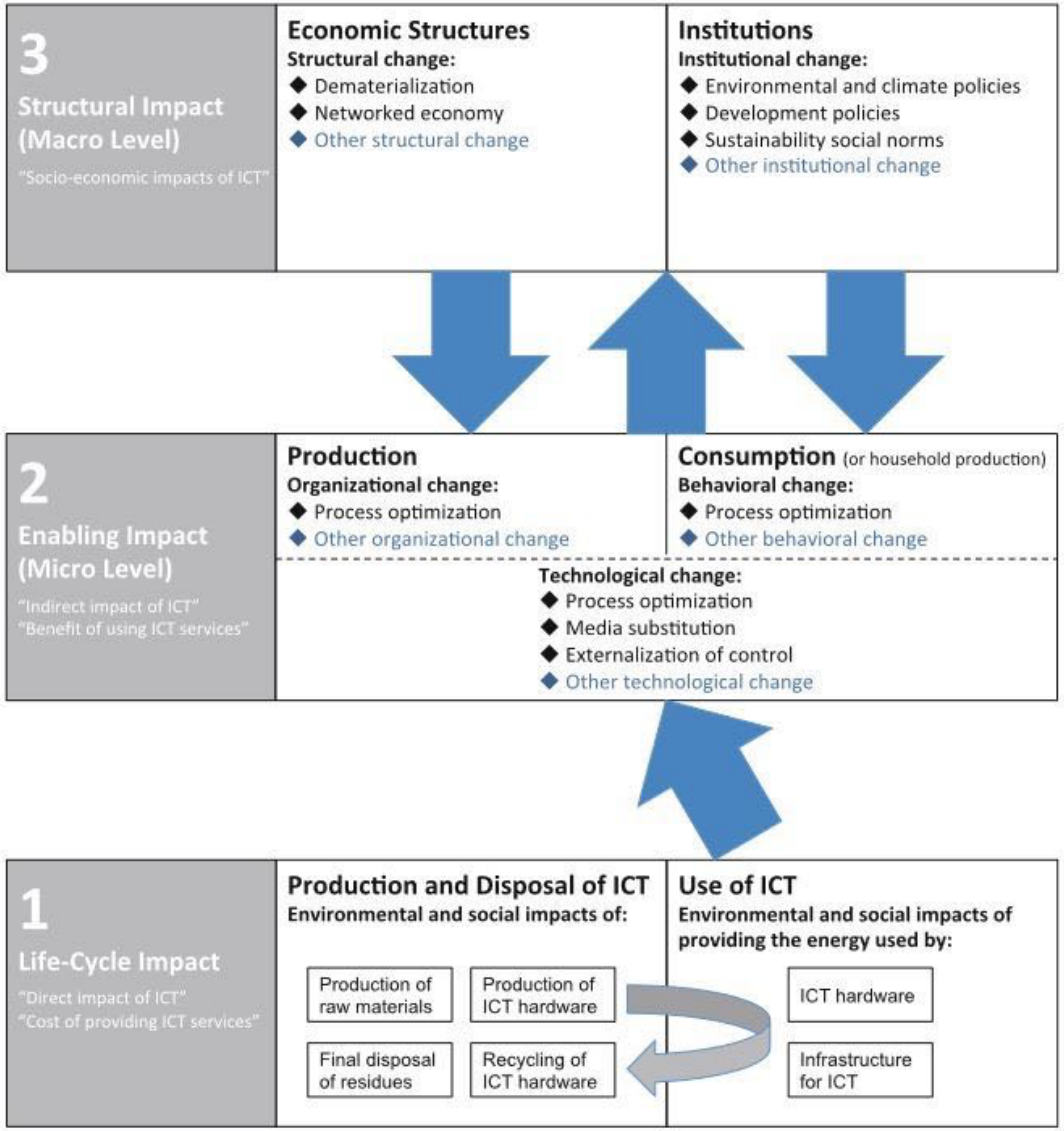
Systemic and structural effects are difficult to consider

- A digital innovation looked at from a use-case perspective may have a handprint bigger than its footprint, but what counts from a sustainability perspective is how the innovation scales up to the macro level. (E.g., there can be rebound effects).
- Even less, structural change, such as the change of markets structures, institutions, and societal norms, can be assessed with te handprint/footprint scheme. But structural change is what counts for sustainability.

Where does the normative orientation come from?

- It is relatively easy to agree that “less CO2” is better than “more CO2”. However, there are more controversial judgements about what is desirable or undesirable for society, also in the sustainability discourse. The handprint/footprint scheme assumes that we have undisputed indicators, which is not always the case.

5. LES-Model



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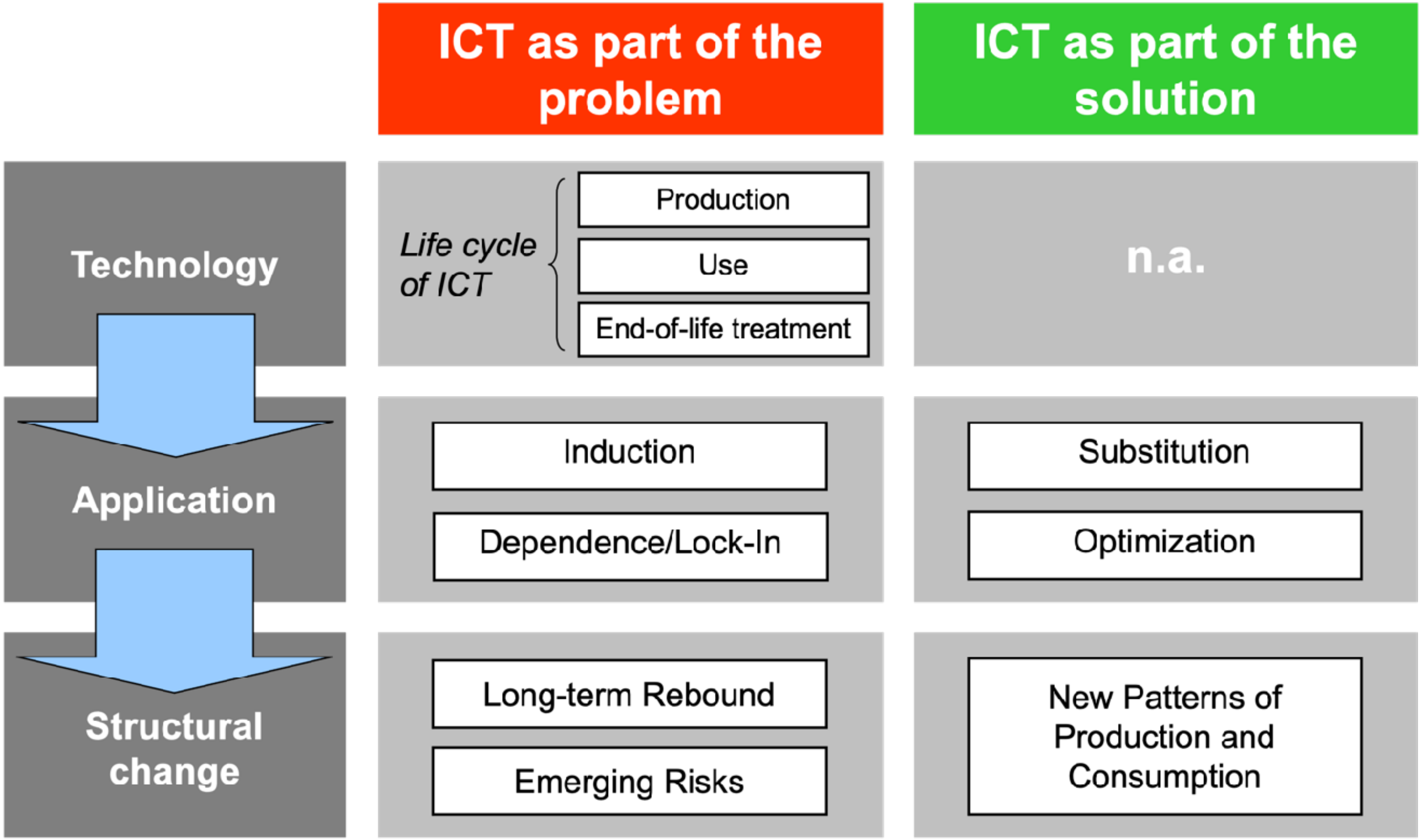
6. The Predecessor



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What if IT would be Medicine?

“Patient autonomy:
The right of patients to **make decisions about their medical care without their health care provider trying to influence the decision**. Patient autonomy does allow for health care providers to educate the patient but does not allow the health care provider to make the decision for the patient.” (Bernstein, 2018)

As users of computers and smart things, we are massively influenced in how these things are “cared for”.

Several movements and regulations are supporting the idea of user autonomy at least partially:

- “Digital self-determination” as an international movement, focusing on **equal access,**
- “Informational self-determination” (in the German Law since 1983) and the EU General Data Protection Regulation (GDPR) from 2018, focusing on **individuals’ rights over personal data,**
- Prohibition of practices that could **harm the user,** in particular manipulative techniques (EU AI Act, 2024.

1. What is the Purpose of Software?

To avoid having to modify or replace hardware.

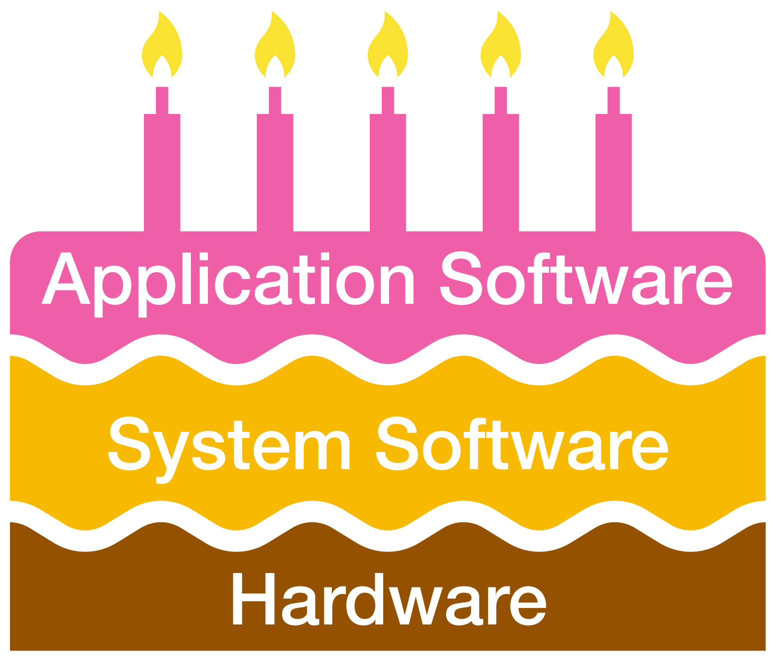
In theory, this is a very sustainable idea:

- The computer as a **universal machine** can be made to **perform any function** that is computable by just replacing software.

  —> This saves resources to build hardware.

- The user can decide what software is added and executed to perform what function.

  —> This gives the user freedom and power



From practice, we all know that …

- Software updates are a common reason for hardware becoming **obsolete**.
- Software does not always act in the interests of the user, but also in the interests of its provider.

How could it happen that the core idea of digital technology was turned upside down?

1. What is the Purpose of Software?

2. What Type of Good is Software? (1/2)

Classification of goods by "materiality":

	transportable/ storable	non-transportable/ storable
Tangible good	all tangible goods	-/-
Intangible good	information goods	all services

- Software is an information good.
- Providing or executing software (e.g., remotely) is a service (Software-as-a-service, SssS).

Classification of goods by information asymmetry:

Search good	The quality can be assessed **before** purchase	e.g., clothing
Experience good	The quality can only be assessed **after** consumption	e.g., restaurant visit
Credence good	The quality **cannot be fully assessed** even after consumption	e.g., medical services

- Software is an experience good in the best case.
- The more "dynamic" a software product is, the more it becomes a credence good (less time for the user to gain experience).

2. What Type of Good is Software? (2/2)

Example for abused trust: Dieselgate

- Software to cheat emissions tests was built into millions of cars.
- NOx emissions linked to the use of defeat devices have led to tens of thousands of premature deaths and of asthma in children between 2009 and 2024 (in UK and EU).

3. Are Software Products Stable and Reliable?

- No, most software products are changed frequently for various reasons. Update frequency increased from **years** in the 1980s ands 1990s to **weeks and days** today. Users have become accustomed to this “software evolution”.
- In principle, there is nothing to be said against adapting a product while it is in use, provided that the result matches the user's intentions.

Type of update by purpose	What does it mean?	Can the user opt out?	Should the user be in control?
Bug Fix	Small errors corrected	not relevant	not relevant
Security Update	**In fact: a recall action**	not a good idea	YES, but there is no real choice at this point
Feature Update	New features added or existing features changed	**usually not**	**YES**
Performance Improvement	Ideally: running with less hardware resources	usually not	no
Compatibility Updates	Technical environment has changed (“eco-system”)	usually not	YES, but there is no real choice at this point

The practice of **combining** update types

eliminates the last bits of user autonomy.

4. What Are the Predominant Business Models in the Digital Economy?

Business Models by Type of Revenue	Description	User pays by…
Advertising-Based	**Monetizes user attention via targeted ads.**	**attention**
Data Monetization	**Uses collected user data to create insights or sell access to it.**	**behavioral data**
Ecosystem Lock-in	Offers integrated products to lock users into an "ecosystem".	partly by accepting high switching costs
Subscription-based	Information good or service paid via subscription.	flat rate
Licensing	Right to use software bought for an unlimited or limted time.	flat rate
Dual Licensing	Proprietary or open-source software licensing for commercial use.	flat rate
Freemium (free+premium)	Free use of basic features plus paid additional services	free plus consumption-based fee
Open Source plus Support	Free software plus paid support services	free plus consumption-based fee
Usage-Based Billing	Based on how much of a service is **consumed**	**consumption-based fee**

Seemingly free, but in fact based on **barter**.

A **sustainable economy** needs prices that are telling the truth and transparency about supply chains.

Only **usage-based billing** is setting the right incentives.

Seemingly free services are difficult to tax, reduce the acceptance of transparent pricing and undermine information services that are based, e.g., on quality journalism and editorial responsibility.

5. How Are Users Influenced by Software and Digital Services?

The consumer behavior and political opinions of users are systematically influenced, **as this is how user data is monetized:**

- **Influence-as-a-Service** (IaaS) has already existed as a business model based on social media that goes much further than just innovative marketing, especially in emotional targeting (Merton 2025).
- The same techniques wil become much more effective if used with **AI systems acting like companions**. Because people tend to anthropomorphise things that talk to them and develop emotional bonds (ELIZA effect).
- There is evidence that people tend to **trust** such AI systems and even assume **neutrality** of these systems. E.g., children who were provided with an AI system helping with their homework used the system also to discuss problems they had with their parents (TA-Swiss, 2025).

Conclusion

Five Steps to the Disempowerment of the User

1. Let software work **against and not for the longevity** of the user's devices and infrastructures.
2. Make sure that software becomes a **credence good** by turning it into a permanent construction site.
3. Increase update frequency and **do not leave the user any real options** for updates.
4. Use business models that **incentivise consumption** through non-transparent pricing, in particular through bartering and flat rates.
5. Monetise user behavior data through **Influence-as-a-Service** and use AI systems to boost emotional targeting.

Negative Impacts on Sustainable Development

1. Total **footprint** of digital technologies will increase because their production has a much bigger footprint than their operation (e.g. Axenbeck et al. 2025).
2. Being doomed to trust blindly, users are not in a position to **act morally**.
3. This reinforces problems 1 and 2 and **information asymmetry** in the IT world. Information asymmetry is a major cause of market failure.
4. The **illusion of free services** creates taxing issues and reduces the general acceptance of services with prices that are telling the truth.
5. Influence-as-a-Service is a **threat to society,** it undermines fair competition, public discourse and democratic processes.

Final Remarks on How We Should Use AI Systems

ChatGPT has created these 10 rules on my instruction.

10 Rules for Dealing with Seemingly Human Machines

1. Call it what it is.

Not a 'friend', not a 'person'. It is a system, a program, an artifact, a thing.

2. Don't believe it feels.

AI shows no emotions-it simulates them.

3. Avoid emotional dependence.

A thing can listen – but not empathise.

4. Don't delegate responsibility.

An technical system must not make moral decisions you wouldn't make yourself.

5. Question its agenda.

<u>Who programmed it? Whose interests does it serve? Neutrality is rare.</u>

6. Learn to turn it off.

Technical behavior must not become a social obligation.

7. Protect your data – and your attention.

<u>What you reveal becomes capital.</u>

8. Watch your language.

The more human you call it, the more you blur the boundary.

9. Remember the difference:

Humans can be hurt. Machines can't.

10. Stay in the ambivalence.

A thing can be useful, impressive – and still not a counterpart.

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