MUTUAL SHAPING BETWEEN TECHNOLOGIES AND LAW: MEMORIES OF NORWEGIAN E-HEALTH INFRASTRUCTURES

PhD defense
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MOTIVATION

- PhD is just a start!...
- PhD is a fingerprint of my own intelligence
- PhD is a feedback to Norwegian taxpayers (REACH, Research Council of Norway)

HOW DO TECHNOLOGIES [ICT] AND LAW MUTUALLY SHAPE EACH OTHER?
FINDINGS

Ontological contribution

• Shaping of ICT and law is a holistic phenomenon, which emphasises:
  - Temporality and simultaneity
  - Mutuality of information shaping
  - Multiplicity of situations and uniqueness of learning

Epistemological contribution

• A procedural, holistic, systems approach, which emphasises:
  - Time-tagging and conditionality
  - Relationships across elements/situations
  - Bottom-up information accumulation and predictability of learning
EMPIRICAL SETTING

HealthBook

Similarities:
- E-health solutions
- Norwegian legislative context
- Emerging technologies

Differences:
- A private initiative
- Sharing data from patient to healthcare
- Any data for healthcare purposes

National Core Journal

Similarities:
- A public-sector initiative
- Sharing data across healthcare institutions
- Critical health data

DATA: reports, proposals and opinions, e-mails, specifications (200 doc.), interviews (over 10), etc.
Socio-Technical Systems

Legal Informatics

Information Systems

Socio-Technical Systems

Systems thinking: abstraction, computation of the logic

Systems thinking: visualization

Systems thinking: logic as a technology, research as technology

Systems thinking: talk to Physicists – they don’t bite

Systems thinking: 50% practice + 50% theory

Knowledge to Respond: Transdisciplinarity
ABSTRACTION OF RELATIONSHIPS & TIME

A process and a complex system of elements and in interaction
A process and a complex system of elements and in interaction

MEMORY – «retained parts of the input history» (Holland, 1992, p. 23); memory is required «to restore predictability by taking the system’s past history into account, a coding property” (Ashby, 1956, pp. 115-116)
# Visualizations of Abstractions

Elements, relationships and time, where everything happens bottom up and every opinion matters

<table>
<thead>
<tr>
<th>Dataset 1: HealthBook</th>
<th>Dataset 2: National Core Journal</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ 51 elements of technology</td>
<td>▪ 451 elements of technology</td>
</tr>
<tr>
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Elements, relationships and time, where everything happens bottom-up and every opinion matters.
Dataset 1: HealthBook
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Elements, relationships and time, where everything happens bottom up and every opinion matters.
RELATIONSHIPS AND THEIR CLUSTERS

The role of the relationships is emphasized

Information transfer and interactions of meanings are found in clusters with links, or relationships, of colors different from the colors of their elements
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Thus, in “event” 1 (red), I have: research status, t+2; being not a registry, t+2; archiving, t+2; internal control & security, t+2; right to insight, t+2. In “event” 2 (orange), I have: anonymity, t+3; responsibility distribution, t+3; disposal of health data, t+6; responsibility distribution, t+6; Health Personnel Number, t+8; legal representatives, t+8; children welfare, t+8; research status, t+9; Personal Security Number, t+9; Health Personnel Number, t+10; legal representatives, t+10. In “event” 3 (rose), there are: being not a registry, t+7; cross-accessibility, t+7; disposal of personal data, t+7; non-sensitivity of the personal data for private purposes, t+7; user takes all the risks, t+7; archiving, t+8. “Event” 4 (violet) consists of: responsibility distribution, t+15; non-sensitivity of the personal data for private purposes, t+15; research status of the technology, t+16; commercial status of the technology, t+17. In “event” 5 (blue), I have: patient-oriented approach, t+7; being not a registry, t+7; the patient/user having access/ownership and disposal over the own data, t+7; being beyond the law, t+7; having no “master” key for the information system, t+7; remote service for users, t+11; delegated access, t+11; back up, t+11; simplicity, t+11; storing user’s data at one place, t+11; security mechanism, t+11; uploading mechanism, t+11; authentication, t+11; strategy to be outside existing IT, t+11; developing Facebook for health, t+11; having compatibility for issuing data in electronic form, t+11; the channel “from healthcare to patient”, t+11. “Event” 6 (grey) consists of: central server for database, t+9; delegated access by users, t+9; five categories of files to upload, t+9; search engine, t+9; simplicity, t+9; security mechanism, t+9; bank-ID, t+9; upload mechanism, t+9; identification, t+9; authentication, t+9; blue light function, t+9; tagging of files, t+9; encryption, t+9. Finally, “event” 7 (brown) has: five categories of files for data upload, t+10; simplicity, t+10; security mechanism, t+10; bank-ID, t+10; authentication, t+10; blue light, t+10.
Thus, in “event” 1, internal control & t+3; responsibility, t+6; Health Personnel status, t+9; Personal representatives, t+7; accessibility, t+7; private purposes, t+15; research statistically “event” 5 (blue), patient/user having law, t+7; having a t+11; delegated accuracy t+11; security measures to be outside existing issuing data in categories of files 6 (grey) consists for five categories of files bank-ID, t+9; up function, t+9; tag categories of files t+10; authentication
Thus, in “event” and “state”, we have to specify internal control & security. The role of the relationships is emphasized. Information transfer and interactions of meanings are found in clusters with links, or relationships, of colors different from the colors of their elements.
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In “event” (1) marked dark orange, there are: Documented drugs, t=7; Documented drugs, t=13; EPJs, t=13; KJ as access to patient information (“Kernjournal”), t=13; Transfer of patient data, t=13; Update data, t=13; Identification of patient, t=13; Confirmation of relations in treatment between a patient and health personnel, t=13; Patient information and EPJ-document, t=13; Classification of drugs at levels of healthcare, t=14; Treatment code with common standards, t=14; Personal qualified certificate, t=14; Create KJ, t=15; Trust, t=15; Log, t=16; Authentication of organization, t=18; Health personnel number, t=18; Prescription, t=18; Centralization of information, t=18; Update data, t=18; Block some type of data, t=19; Prescription, t=19; CAVE or contraindicated drugs, t=19; Synchronization, t=20; Prescription, t=21; No direct registration of patient data in KJ, t=21; Update data, t=22; Manual fill in, t=22; Overview over all drugs in use, t=24; EPJs, t=24; KJ as access to patient information (“Kernjournal”), t=24; Information systems of car- and air ambulances, t=24; Function of KJ to collect data, t=24; EPJs, t=26; Authentication of health personnel, t=26; Automatic update, t=26; No manual routines at all, t=28; Trust, t=30; Digital signature for health personnel, t=32; Digital signature for patient, t=32; Overview over all drugs in use, t=32; Access control system, t=32; Prescription, t=32; Framework for critical information, t=32; Authentication of user, t=32; Free text field, t=32; Log, t=32; Event-registering, t=32; Update data, t=32; Documented drugs, t=32; CAVE or contraindicated drugs, t=32; Previous and chronic diseases and standards for them, t=32; Contact details of GP, t=32; Structured data and colors, t=33; Integration of information systems, t=33; Block some type of data, t=33; EPJs, t=34; Automatic update, t=34; Information about patient, t=34; Data on reservation, t=34; Treatment that should not be, t=34; Other critical data, t=34; Integration of information systems, t=37; Blocking of transferring some sensitive data to KJ is not possible, t=48; No manual routines at all, t=57; Professional systems of health personnel, t=58; Structured data and colors, t=58; Integration of information systems, t=58; Automatic update, t=58; Connection technology between local systems and KJ, t=58; Issue of the real-time data, t=58; Allergy data, t=64; Data on medical state, t=64.

In “event” (2) marked red, there are: Cross-over organizations, t=5; Cooperation, t=5; Right to choose hospital, t=5; Privacy protection (“personvern”), t=6; Privacy protection (“personvern”), t=13; To exercise medical help, t=13; Bylaw on KJ, t=13; Cross-over organizations, t=13; Access to own patient data viewing (“immsyn”), t=13; Logging as guarantee, t=13; Minors, t=13; Patient consent, t=13; Information security, t=15; Privacy protection (personvern), t=15; Patient security, t=15; Access control, t=16; Conditions for access to KJ must be stated, t=16; Bylaw on KJ, t=16; Access to own patient data viewing (“immsyn”), t=17; KJ as a central health registry, t=18; Privacy protection (“personvern”), t=18; Transfer of data to employment etc. is not allowed, t=19; Control over data by patient, t=19; Logging data shall be stored for 10 years, t=19; Data controller (“datbehandlingsansvarlig”), t=20; Blocking of data by health personnel to reject the access (“immsyn”) by patient, t=20; Healthcare service levels, t=22; Patient security, t=22; Cross-organizational treatment-oriented health registry is not allowed, t=25; Logging as guarantee, t=25; Patient security, t=25; Logging as guarantee, t=26; Privacy protection (“personvern”), t=26; No consent required, t=26; The Norm, Quality and efficiency, t=26; Research activity, t=26; Rights to access (“immsyn”) by varied health personnel groups, t=28; Transfer of data to employers etc. is not allowed, t=29; Confidentiality, t=29; Control over data by patient, t=29; Patient

Thus, internal...
Mutual shaping between technologies and law as a process and complex system, where time matters just as relationships.

Time-tagging relocation + keeping the importance of the diverse colors of the relationships.
## Mutual shaping between technologies and law as a process and complex system, where time matters just as relationships

### Info

| t+2 – red: | research status, being not a registry, archiving, internal control & security, right to insight |
| t+3 – orange: | anonymity, responsibility distribution |
| t+6 – orange: | disposal of health data, responsibility distribution |
| t+7 – rose: | being not a registry, cross-accessibility, disposal of personal data, non-sensitivity of the personal data, user takes all the risks; blue: patient-oriented approach, being not a registry, user's ownership over own data, being beyond the law, no “master” key for drift and inf. syst. |
| t+8 – orange: | Health Personnel Number, legal representatives, children welfare; rose: archiving |
| t+9 – orange: | research status, Personal Security Number; grey: central server for database, delegated access by users, categories of files to upload, search engine, simplicity, security mechanism, bank-ID, upload mechanism, identification, authentication, blue light function, tagging of files, encryption |
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- **Time-tagging**: Relocation + keeping the importance of the diverse colors of the relationships.

- **Access to own patient data/viewing** (“improp”) — **rose**: Access to own patient data/viewing (“improp”).

- **The Public Health Portal Helsine.njoe**: Framework for critical health information — **light blue**: Cross-organizational treatment-oriented health registry, GP.

- **Integration of information systems**: Standards for the whole infrastructure — **light blue**: Responsible for KJ, Content of KJ.

- **Documented drugs, EPJ, KJ as access to patient information** (“Kjernejournal”), Transfer of patient data, Update data, Identification of patient, Confirmation of relations in treatment between a patient and health personnel, Patient information and EPJ-document — **red**: Privacy protection (“personvern”), To exercise medical help, Bylaw on KJ, Cross-over organizations, Right to choose hospital, Right to protection against data sharing, §6d own norm for KJ — **dark orange**: Documented drugs, EEA-citizens and those with H-number residing in Norway, KJ as a cross-organizational treatment-oriented health registry, Duty to report health data.

- **Diagnostics** — **brown**: Vital and personalized health information.

- **Professional systems of health personnel** — **light blue**: National character of KJ, Accessibility, Data sharing among registries, Objectives with KJ, Data for delivering to KJ, Right to protection against data sharing, §6d own norm for KJ — **dark orange**: Double storage of health data, Distributed storage of health data, Event-registering, Integration of information systems, Block the whole KJ, Block some type of data, Manual fill in, KJ accessible from health personnel via tab or field or button, Not a channel “from patient to healthcare”, KUHR and reimbursement, Access and sharing systems for KJ — **light green**: Citizen and citizenship, EEA-citizens and those with H-number residing in Norway, KJ as a cross-organizational treatment-oriented health registry, Duty to report health data — **brown**: Duty to have KJ in organization, No time-limitations to store references to requests of discharge summaries, Objectives with NPR, Duty to report on processing of health data.

- **Classification of drugs at levels of healthcare** — **dark orange**: Classification of drugs at levels of healthcare, Treatment code with common standards, Personal qualified certificate — **crimson**: Kinds of data allowed to fill in — **rose**: Treatment cycle, GP.
Mutual shaping between technologies and law as a process and complex system, where time matters just as relationships.
Mutual shaping between technologies and law as a process and complex system, where time matters just as relationships. Time-tagging relocation + keeping the importance of the diverse colors of the relationships (VALUED SIGNAL (out of the «memory») definition in the formal framework of natural and artificial complex systems: «Environment is complex, and the adaptive system has an ability to discriminate among various environments. This ability is limited by the range of signals it can receive. Environment is confronting the complex adaptive system by producing a signal. Different structures may be capable of receiving different ranges of signals... If a particular signal was given at a particular time, the component of the signal is a value of the sensor for this signal at that time.” (Holland, 1992, pp. 21-29)
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CONNECTING LAW AND ICT

Dataset 1: HealthBook

- “anonymity”
- “simplicity & security”
- “being beyond the law”
- “research status”

Valued signals: 4

(!) Same pattern – different contents

Dataset 2: National Core Journal

- “patient consent” [t+13]
- “centralization of information” [t+18]
- “synchronization” [t+34]
- “control over data by patient” in [t+19], [t+33]
- “sensitivity of health data” [t+45], [t+56]
- “automatic update” [t+58].

Valued signals: 8 – 2 = 6
SHAPING CHANNELS

- “…attractors that exist in the dynamics of the neural network can be interpreted as concepts, or classes, or memories, or more broadly … the real neurons process this experiential information to yield mental experiences, including classification and memory experiences.” (Kauffman, 2010, p. 181)

- “…autonomous agents do carry out work to construct the constraints… that the energy is released along specific channels… couplings… to propagating organization arise…” … “The web of …activities flows down channels, whose constraints are largely legal in nature… as central to …development and growth” (Kauffman, 2002, p. 229)

- “Design, guided by intent, shapes actions and generates a learning process, as the act of itself stimulates information processing that creates a memory trace and influences future actions.” (Sylves & Comfort, 2012, p. 78)
CONNECTING SITUATIONS

«SHAPING CHANNEL»:

‘from valued signal find legal attractor AND from valued signal find technological implication’

HYPOTHESIS:

Attractors in the national legal environment are shared amongst design works around different technologies.
## PROCESSING THE HYPOTHESIS

### Dataset 1: HealthBook

- from “anonymity” found “informed user” AND from “anonymity” found “username”, “password” and “Health Personnel Number” for the mechanism of user creation and login
- from “simplicity & security” found “responsibilities of the service provider” AND from “simplicity & security” found “security framework” for a simple sharing mechanism
- from “being beyond the law” found “data controller” & corresponding responsibilities AND from “being beyond the law” found “lack of database” to “avoid being a health registry” by the technology
- from “research status” found balancing between “patient journal system”, “health registry” and a third, commercial version in *unclear legal status of journal systems* AND from “research status” found “server at the department” & “a service layer” & “programming language” for subsequent modifications

### Dataset 2: National Core Journal

- from “patient consent” found “informed user” AND from “patient consent” found “consent registration” for the health data “access” and “processing”
- from “centralization of information” found “a registry-in-addition or journal-in-addition” (or uncertain legal status of patient journal) AND from “centralization of information” found “smart card” or “a common system across organizations”
- from “synchronization” found “data controller” & corresponding responsibilities AND from “synchronization” found import/export of patient data between local journals, ePrescription, the Population Registry and the Health Personnel Registry
- from “sensitivity of health data” found “ownership of hardware in architecture to protect the “right to dispose of own health records” by patients” AND from “sensitivity of health data” found national security architecture with the Personal Health Archive as another separate case to consider
- from “control over data by patient” found *emerging patients’ rights to govern their own information elements in particular by the “right to access/view logging data” AND from “control over data by patient” found “solution so that it does not identify the names [of respective health personnel] in a week” to encourage the balance of the autonomy of the patient and the healthcare personnel
- from “automatic update” found “responsibilities of health personnel for health data processing and duty to data transfer in NCJ” AND from “automatic update” found automatically delivered data on drugs and contact with specialists
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PROVIDING THE ANSWER: ONTOLOGY

- Situations of designing ICT – design works – have their own memories
- Each memory accumulates information on ICT, law and expert knowledge from in situ and ex situ
- Information on ICT, law and expert knowledge is clustered in relationships
- Clusters contain valued signals each a legal attractor and a technological implication via a shaping channel
- Legal attractors may be shared by diverse design works, because of the authority of law and its imperfection; so, attractors are foreseeable
PROVIDING THE ANSWER: EPISTEMOLOGY

i: DATASET COLLECTION (design work)
ii: ELEMENT EXTRACTION (design work, memory)
iii: RELATIONSHIP BUILDING (design work, memory)
iv: EVENT EXTRACTION (memory)
v: TIME-TAG ELEMENT RELOCATION (memory)
vi: MICRO-NARRATIVE BUILDING (memory)
vii: VALUED SIGNAL EXTRACTION (memory, shaping channel)
viii: ATTRACTOR RECOGNITION (shaping channel, attractor)
ix: HYPOTHESIS (attractor, design work)

REPLICATION of all the rules for the bottom-up learning in conditionality

All this is bottom-up from the narrative form of data, such as documents and interviews – by narrative parallelism
Legal uncertainty is a possibility to influence legislation by bottom-up decision making.

There are information niches which influence design work processes.

Positioning among other ICTs does not demolish innovation potentials.

Not everything that seems, or popular to say, is what happening.

Evolution of legislation is tracable out of bottom-up decisions.

Some practices of ICT design are not yet mature enough to influence law.
LIMITATIONS AND FURTHER RESEARCH

- Only two datasets, considering the recursiveness of the approach
- Manual character of the approach (normal for language tech. though)
  - Highlighting the ontology of relationships/processes, not objects/definitions
  - Expanding the dataset context: more datasets or scaling up till EU or EEA
  - Deeper digging into why some valued signals were extracted twice
  - Exploration of order in attractors and «events»
  - Anticipation mechanisms of attractors and technological implications
  - Asymmetries and Physics of socio-technical artificial-natural complex systems
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Exploration of order in attractors and «events»

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APPLICATION OF RESULTS

The logic programmable into a IDSS for organizational support and contribution towards:

- Adressing problem-solving in misperception of organizational processes
- Adressing problem-solving in anticipation challenges for your design work
- Adressing problem-solving in organizational data management
- Adressing problem-solving in sticking to initial plans, getting pivoted
- Adressing problem-solving in finding abstract human values behind decisions
- In «diagnosting» legislation out of practical experiences
QUESTIONS?