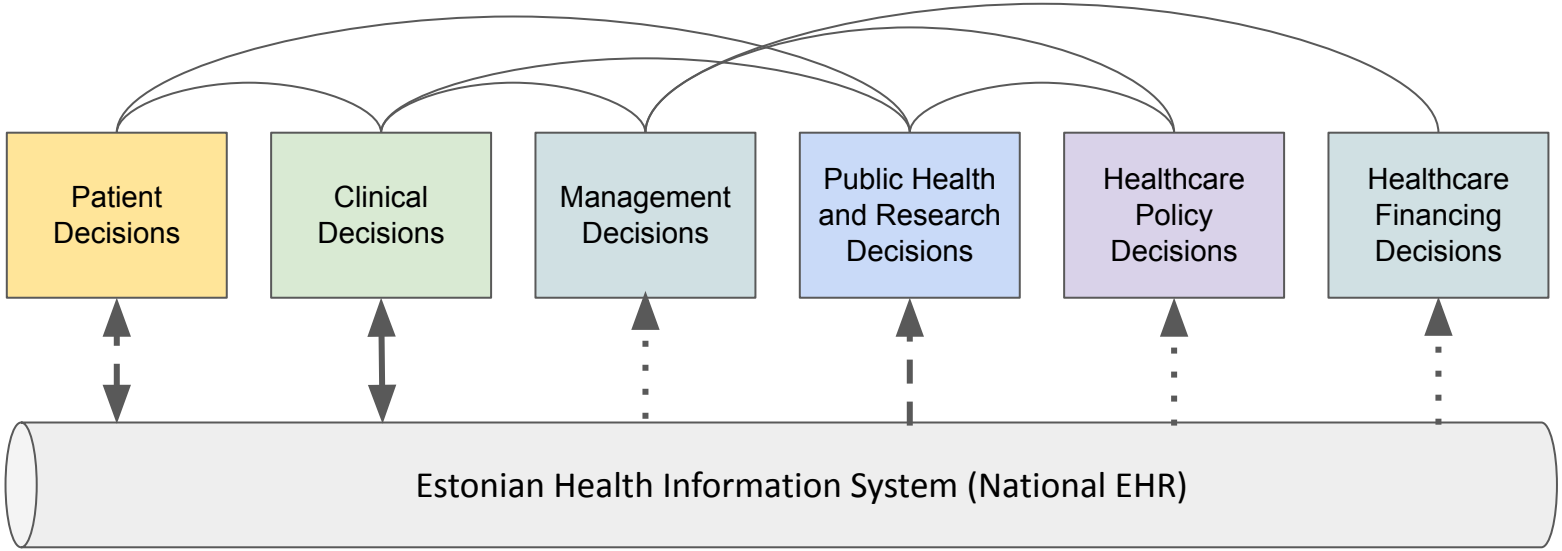
Process interoperability in multi-domain information sharing

Janek Metsallik, E-Health Architect
School of IT, Healthcare Technology
Tallinn University of Technology

Mapping for Hospital Network MP 2040 (2020)

Often the existing model of data exchange requires manual re-capture because of the interoperability issues



1. MAP OF THE CURRENT HOSPITAL SYSTEM. Person-Centred Integrated Hospital Master Plan in Estonia (REFORM/SC2019/140) https://www.sm.ee/et/haiglavork

Looking for better tools for e-health interoperability

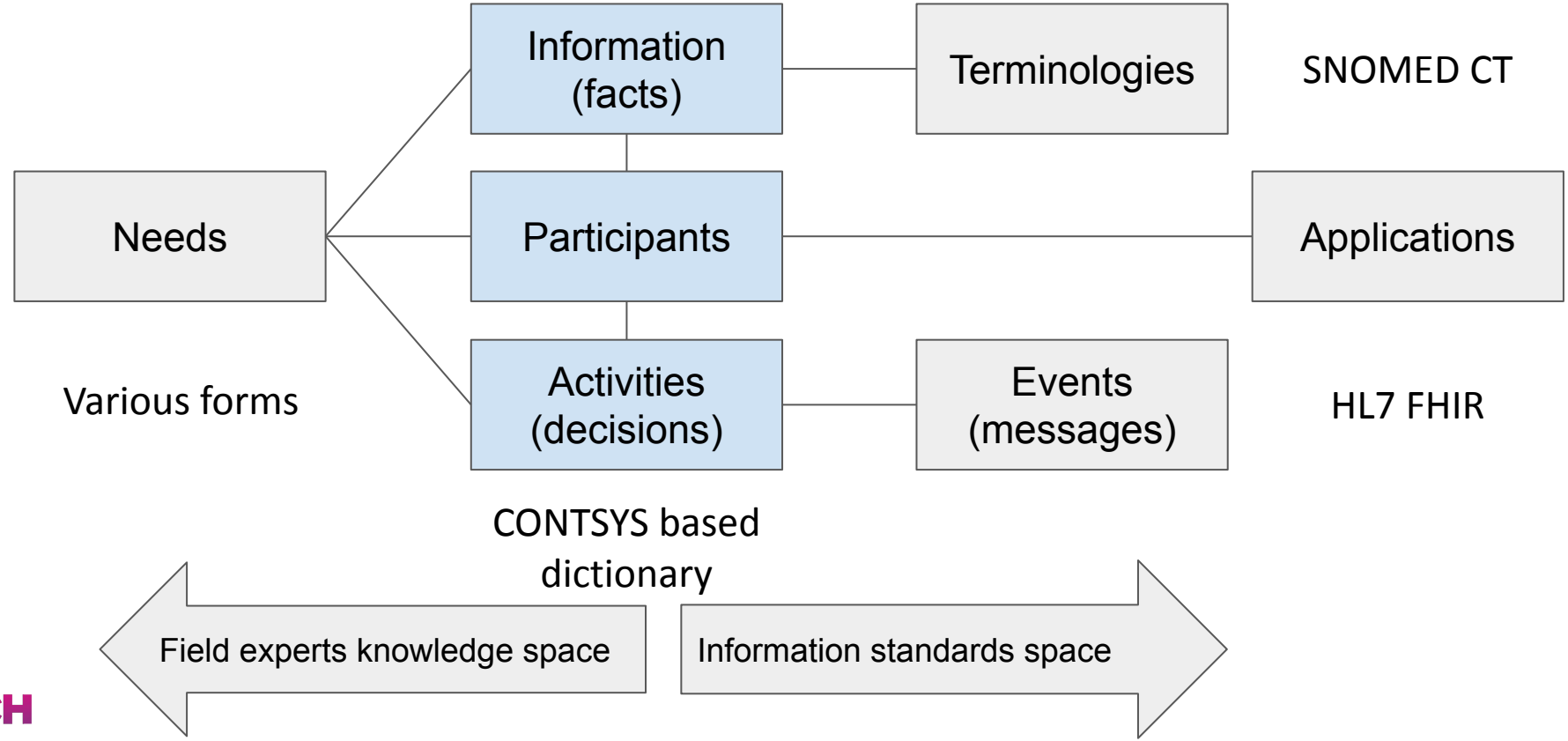
Levels of Conceptual Interoperability Model (LCIM) [1,2]

- **Integrability** - is the data available in the required **location**?
- **Interoperability** - is the data **structure** and **semantics** understood?
- **Composability** - is data **purpose** in a **context** understood?
  - Continuity of flow of information (decisions)

[1] A. Tolk, „Levels of Conceptual Interoperability“, 2003 Fall Simulation Interoperability Workshop.
[2] A. Tolk, L. J. Bair, ja S. Y. Diallo, „Supporting Network Enabled Capability by extending the Levels of Conceptual Interoperability Model to an interoperability maturity model“, Journal of Defense Modeling & Simulation, kd 10, nr 2, lk 145–160, apr 2013, doi: 10.1177/1548512911428457.

TAL TECH

Health Sense project: quest for better model



Decision-making

Decision-making

- selection from a set of alternatives
- using an evaluation criteria
- e.g. medical alternatives:
  - possible diagnosis
  - suitable treatment

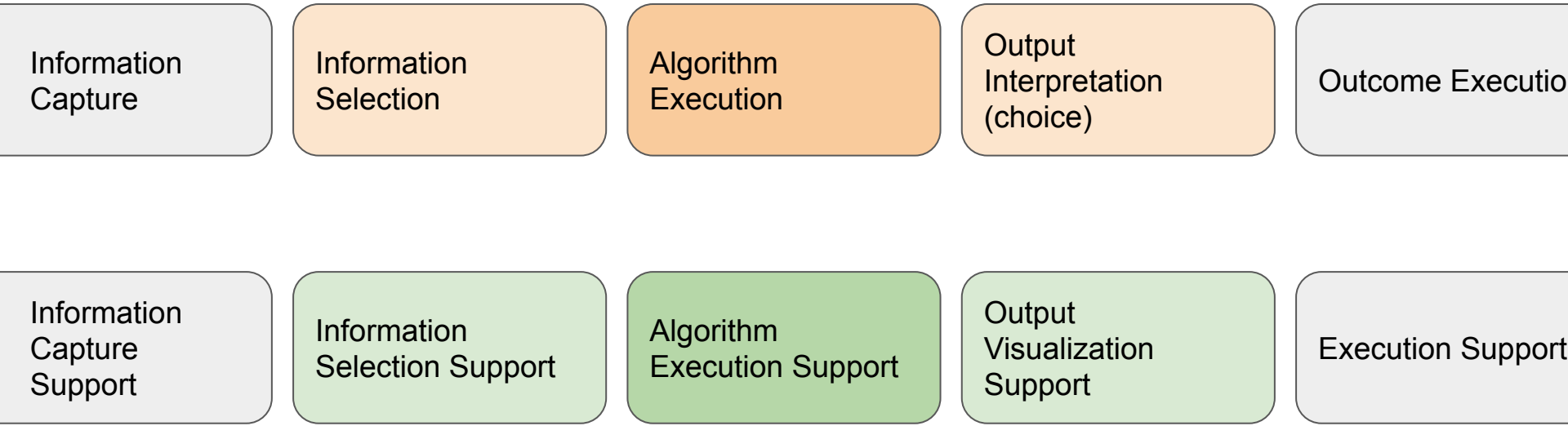
in situations with higher time pressure, higher stakes, or increased ambiguities, experts may follow a decision that fits their experience, and arrive at a course of action without weighing alternatives [2]

TAL TECH

[2]Klein G. Naturalistic decision making. Human factors. 2008 Jun;50(3):456-60.

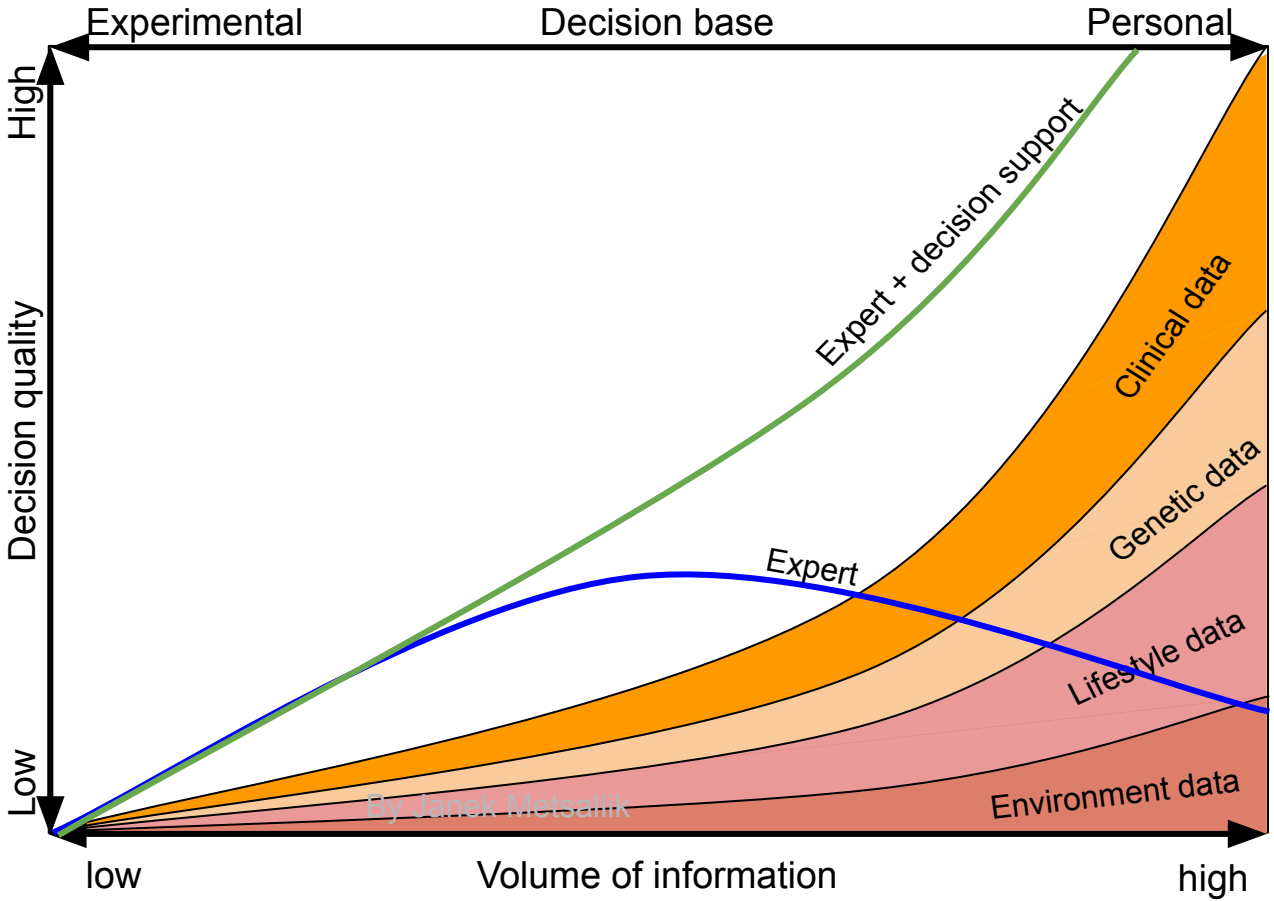
Decision (and) Support

Human supports human decisions
Machine supports human decisions
Human supports machine decisions
Machine supports machine decisions



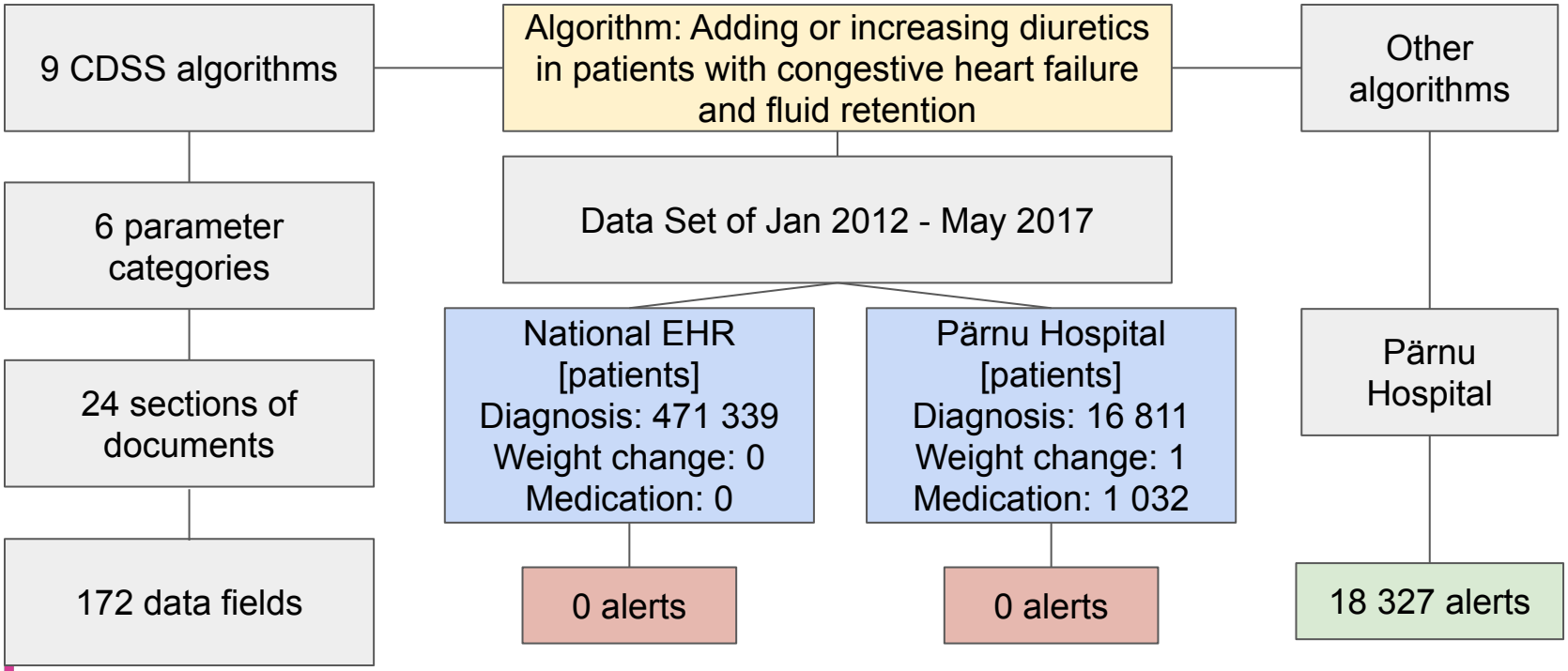
TAL TECH

When is medicine personalized?



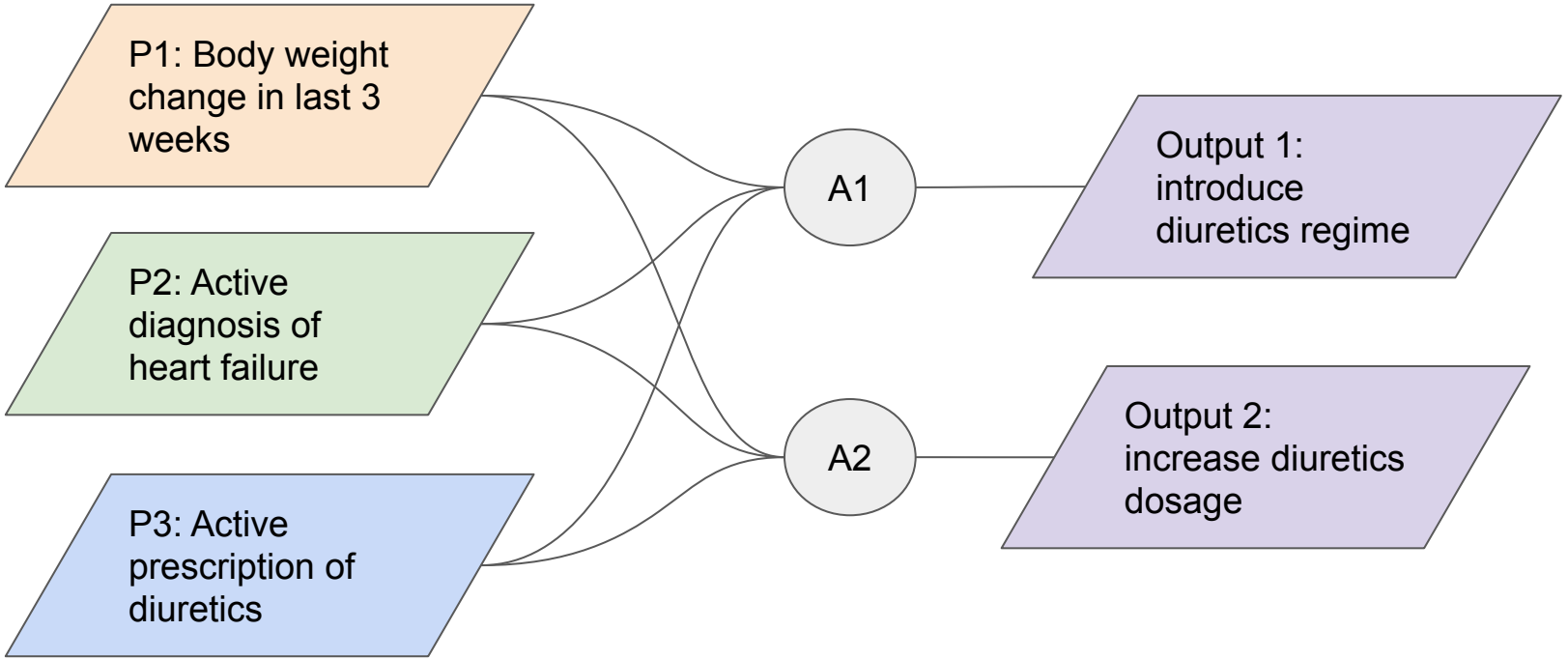
Usability of the National EHR for Decision Support

(EE MoSA + TEHIK + TalTech 2017)



TAL TECH

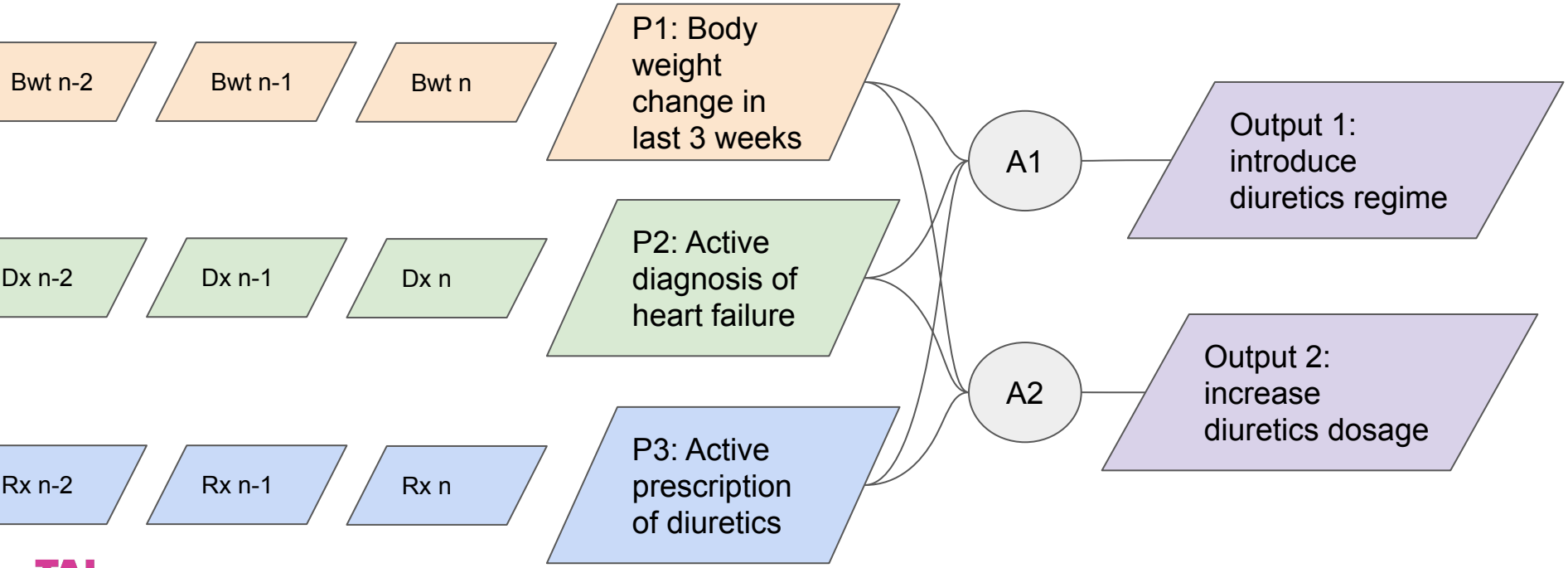
Let’s take a closer look to the algorithm



What if the inputs are not available?

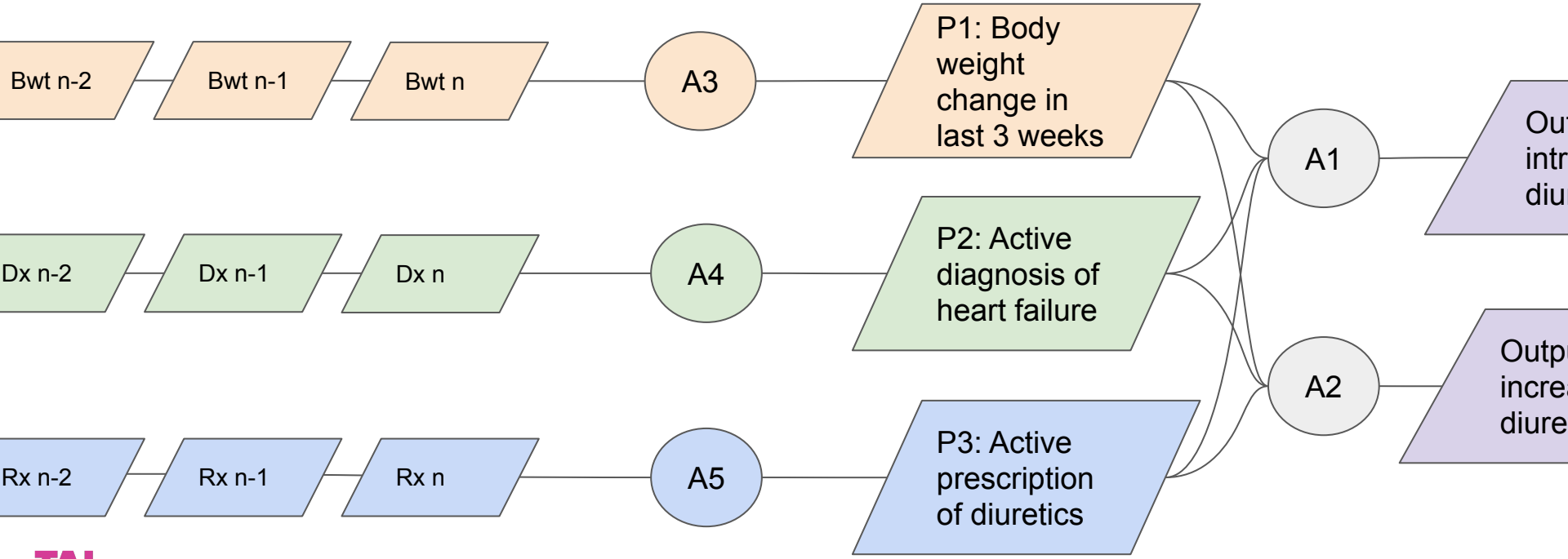
TAL TECH

Inputs for the algorithm come from the patient history



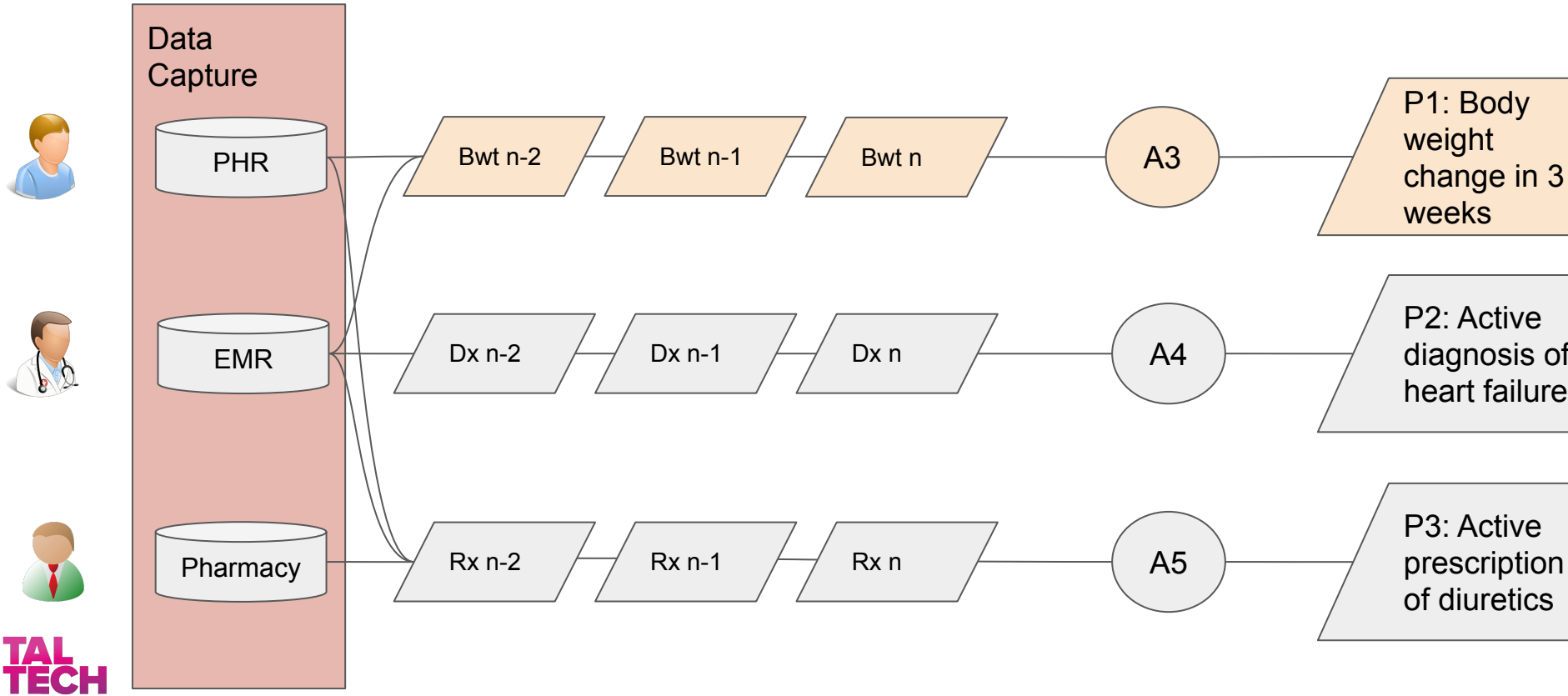
TAL TECH

Event-sourced: algorithm based on a history of events



TAL TECH

Data capture feeds decision-maker with the required data



Demand-driven, Reactive Systems, Backpressure

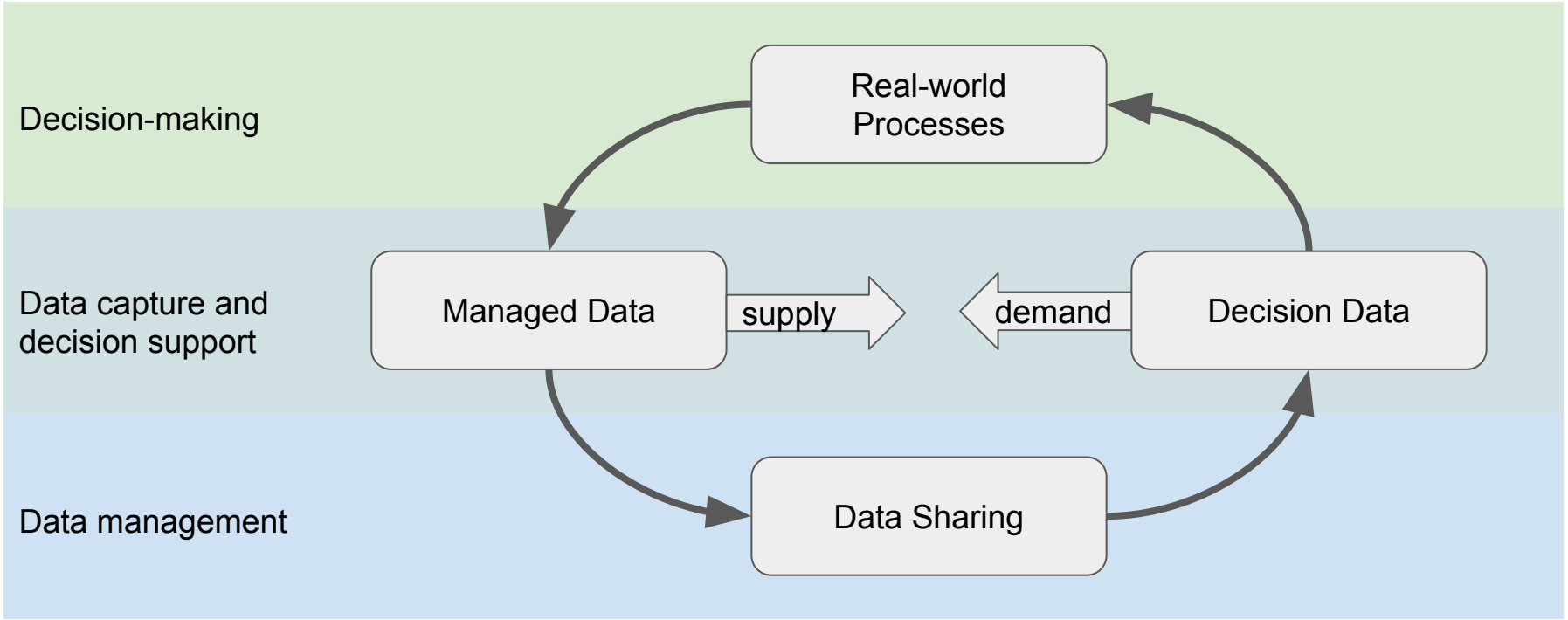
In the world of software, “backpressure” refers to **actions taken by systems to “push back” downstream forces**. As such, it is a defensive action taken unilaterally while under duress or if the aggregate call pattern exhibits too many spikes, or is too bursty.[1]

“Backpressure” enables automatic coordination of the work of supplier and consumer. Depending on the signals from a consumer, a supplier may increase or decrease its volume of production.

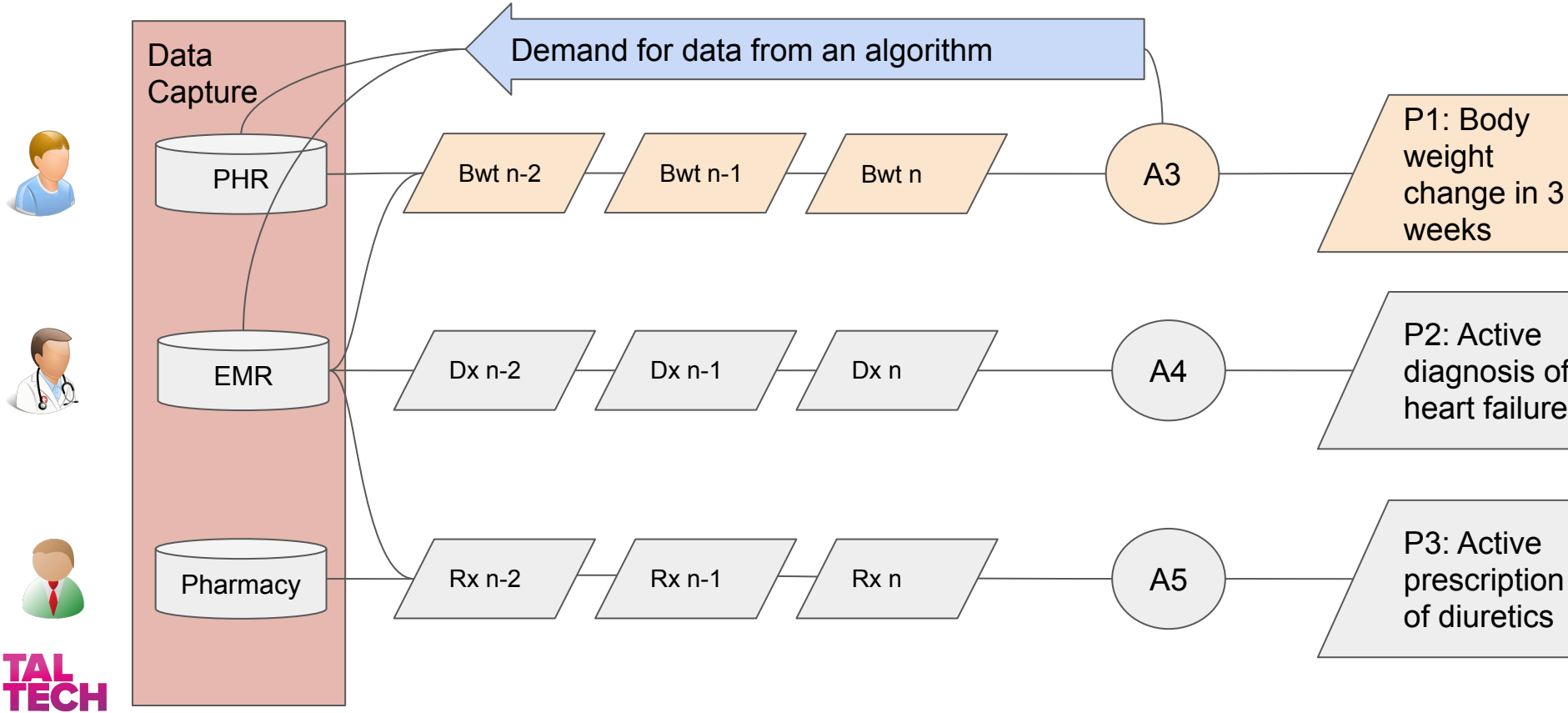
Can the “backpressure” also carry information about the missing content?

[1] https://glasnostic.com/blog/preventing-systemic-failure-backpressure/index.html

Forward and Backward Pressure

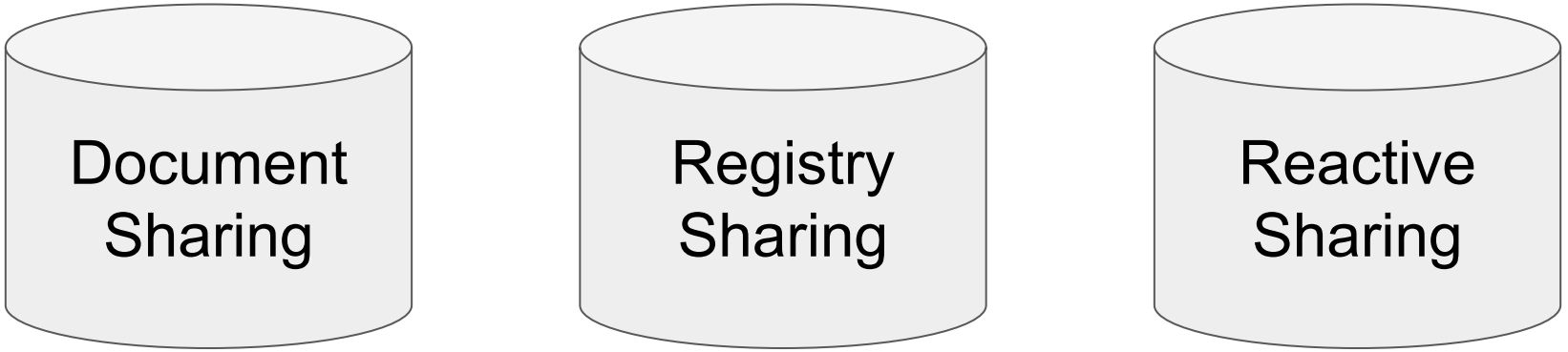


Backpressure



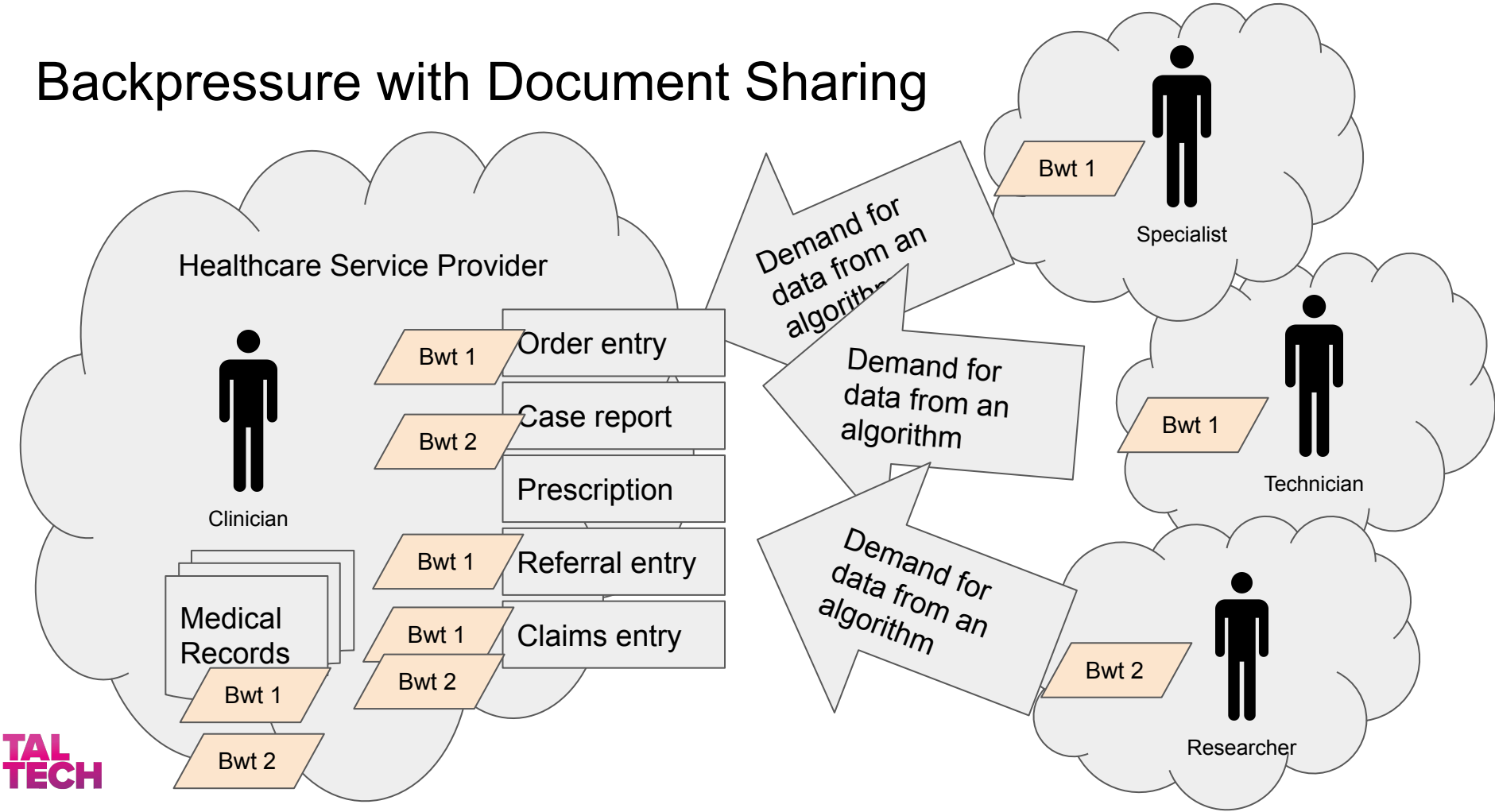
TAL TECH

Governing backpressure in health information sharing



TAL TECH

Backpressure with Document Sharing

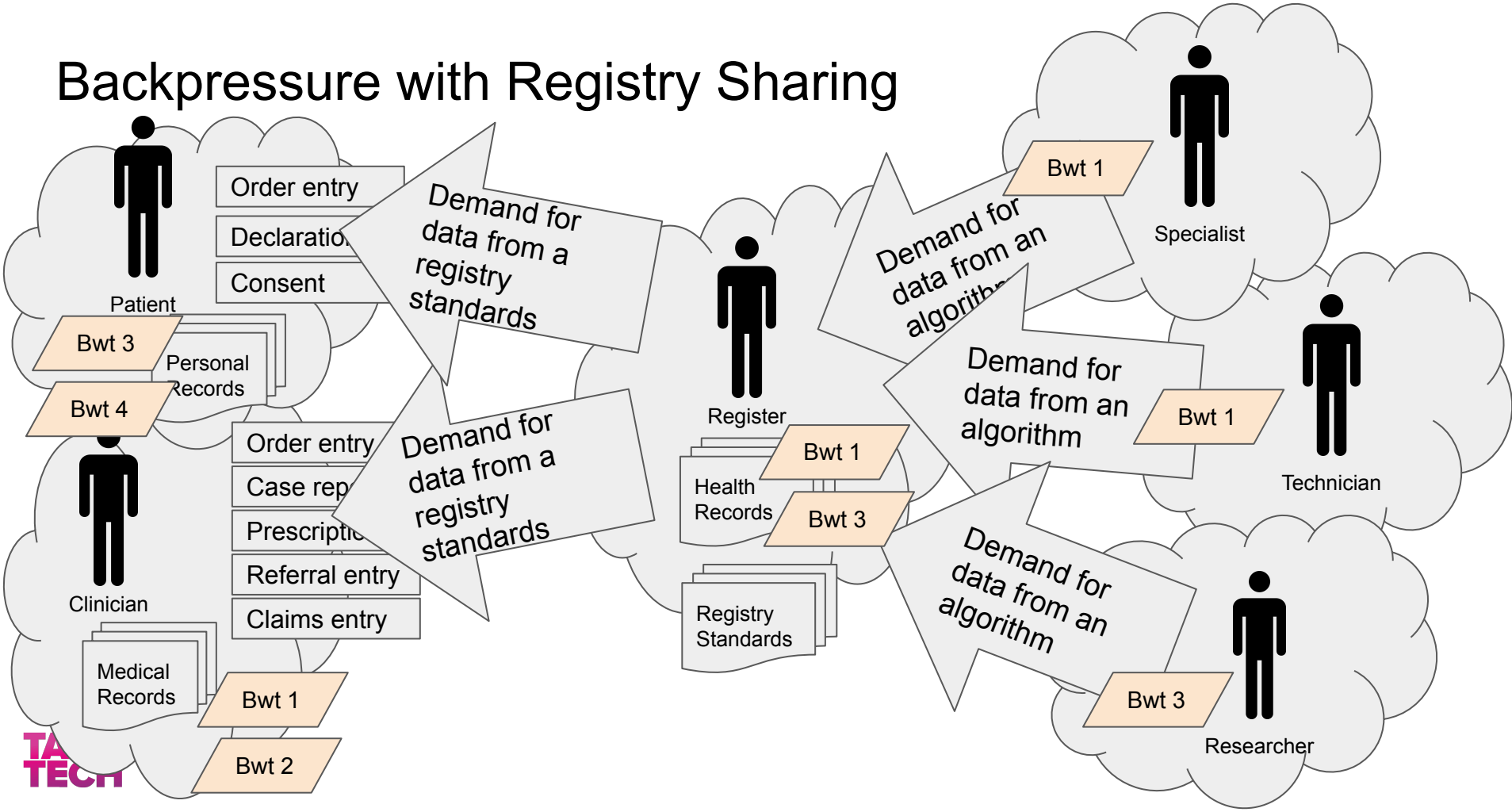


Document Sharing: benefits and tradeoffs

- How the quality of data is controlled?
- How the healthcare process is coordinated?
- How a digital decision support system can be implemented?
- How new data consumers are added?
- What shall/can be governed?
- Where is the full knowledge of patient history?

TAL TECH

Backpressure with Registry Sharing



Registry Sharing: advantages and challenges

- How the quality of data is controlled?
- How the healthcare process is controlled?
- How reliable a registry based decision support system would be?
- How new data needs are introduced? Who is being negotiated with?
- What shall / can be governed?
- Where is the full history of a patient?

How to advance from here?

TAL TECH

What needs governance? How to govern?

public health goals

personal health goals

pathway design

decision guidelines

health terminology

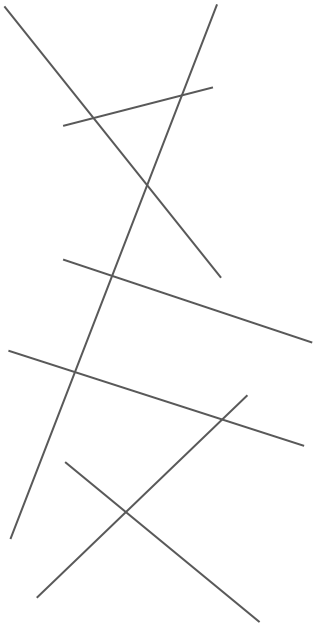
event response agreements

health records data

messaging structures

database platforms

infrastructure blocks



autocracy

central monopoly

federative extensibility

confederative cooperation

multipoly

democracy

anarchistic self-governance

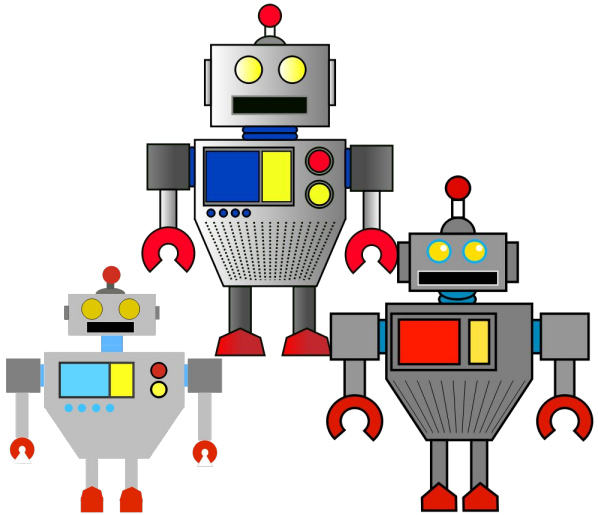
hierarchical coordination

matrix organization

agile devops

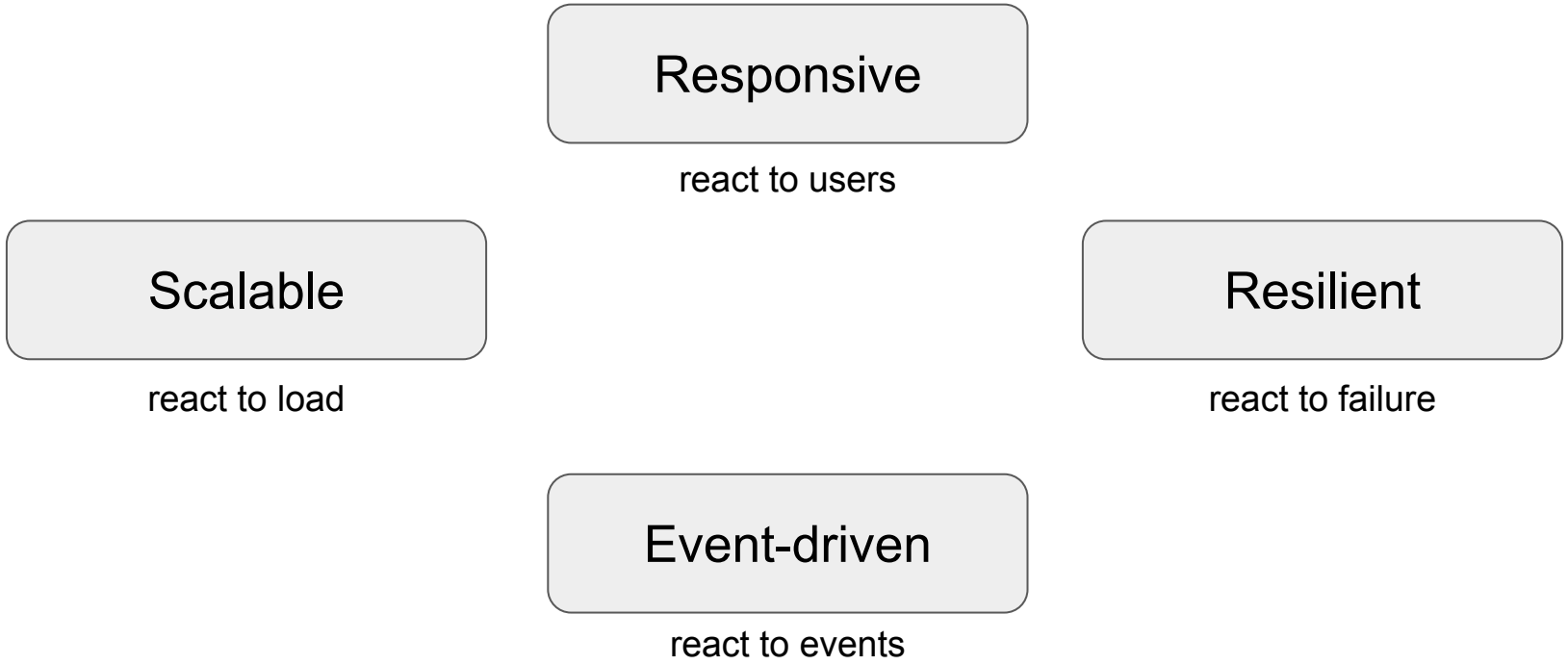
TAL TECH

What about a single central registry of health records?



TAL TECH

Reactive Systems



https://www.reactive.foundation/

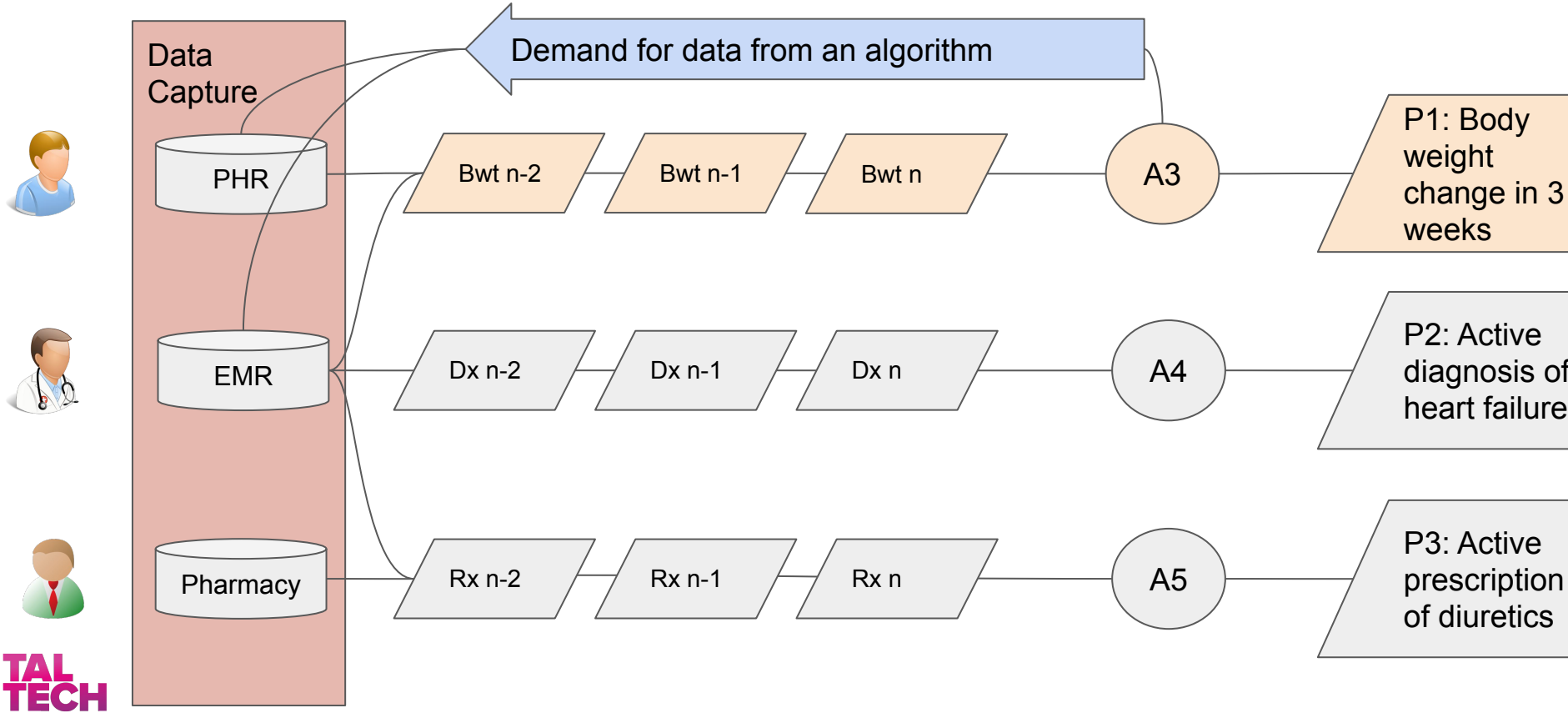
TAL TECH

Reactive health information sharing

- Responsive: react to users
  - Agile adoption of new requirements into information flows
- Scalable: react to load
  - Participants easily join and leave the platform
- Resilient: react to failures
  - Data protection and persistence guarantees by the platform
- Event-driven: react to events
  - Dynamic matching of demand and supply

TAL TECH

Platform shall connect the needs of a consumer with a provider



TAL TECH

Demand-based Medical Records interface

John Smith

body weight?

74kg

Patient has been diagnosed congestive heart failure and is gaining weight. The patient has diuretics prescribed and dispensed. Administration confirmed?

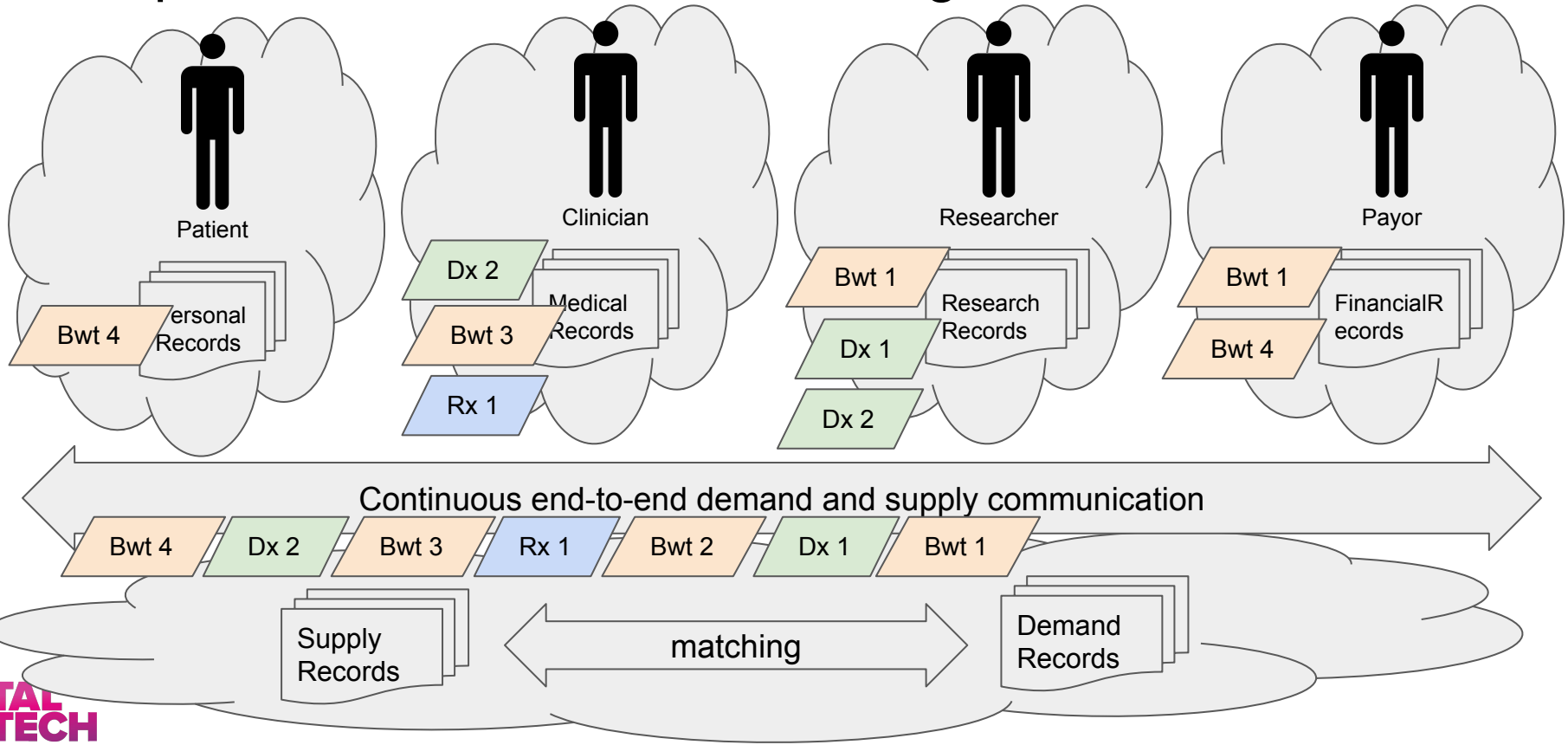
No

Confirm renewing the prescription.

Yes

TAL TECH

Backpressure with Reactive Sharing



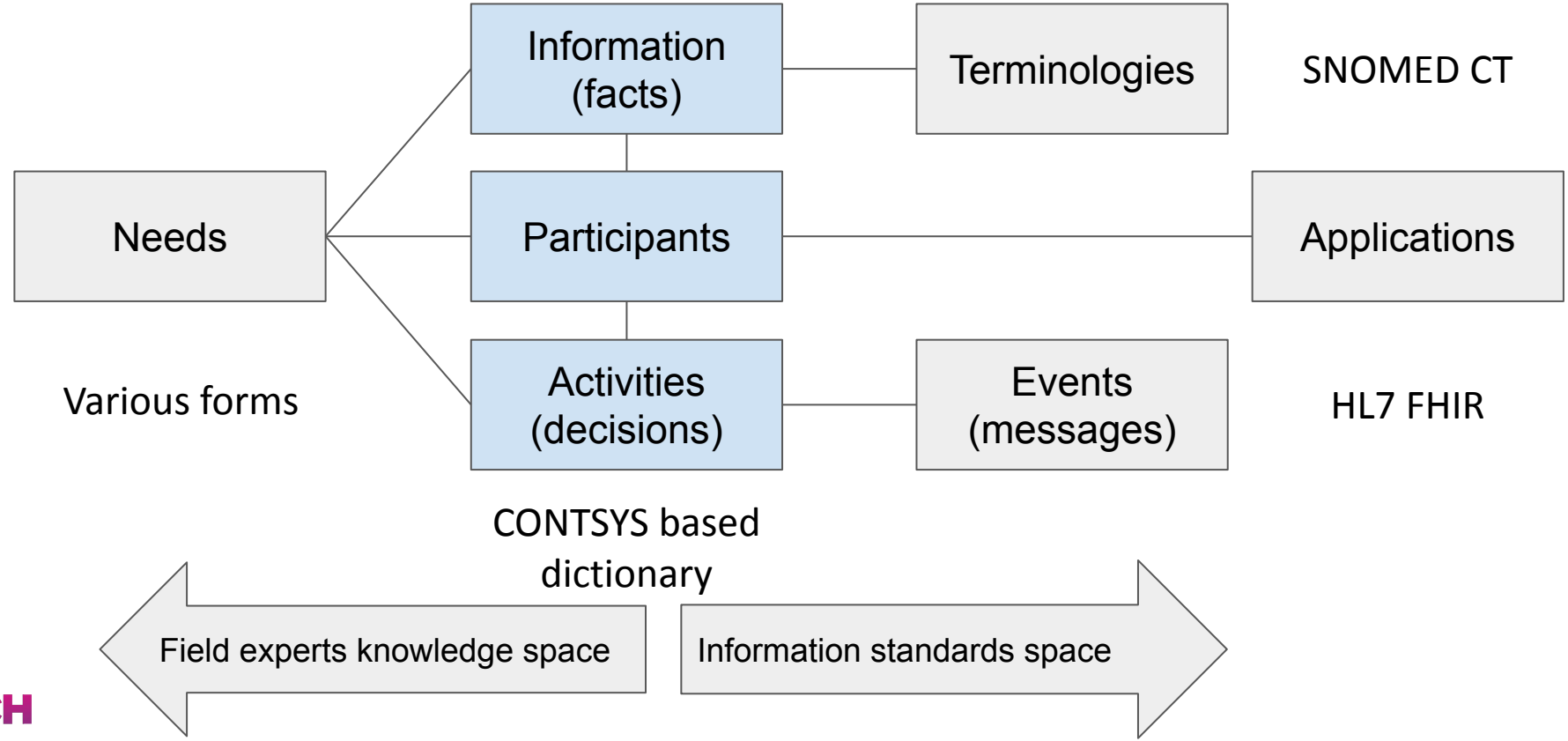
TAL TECH

Reactive Sharing: the expectations

- How the quality of data is controlled?
- How the healthcare process is controlled?
- How to fetch relevant information for decision making?
- How new data needs are introduced? Who is being negotiated with?
- What shall / can be governed?
- Where is the full history of a patient?

TAL TECH

Reactive Sharing: ongoing mapping of demand and supply



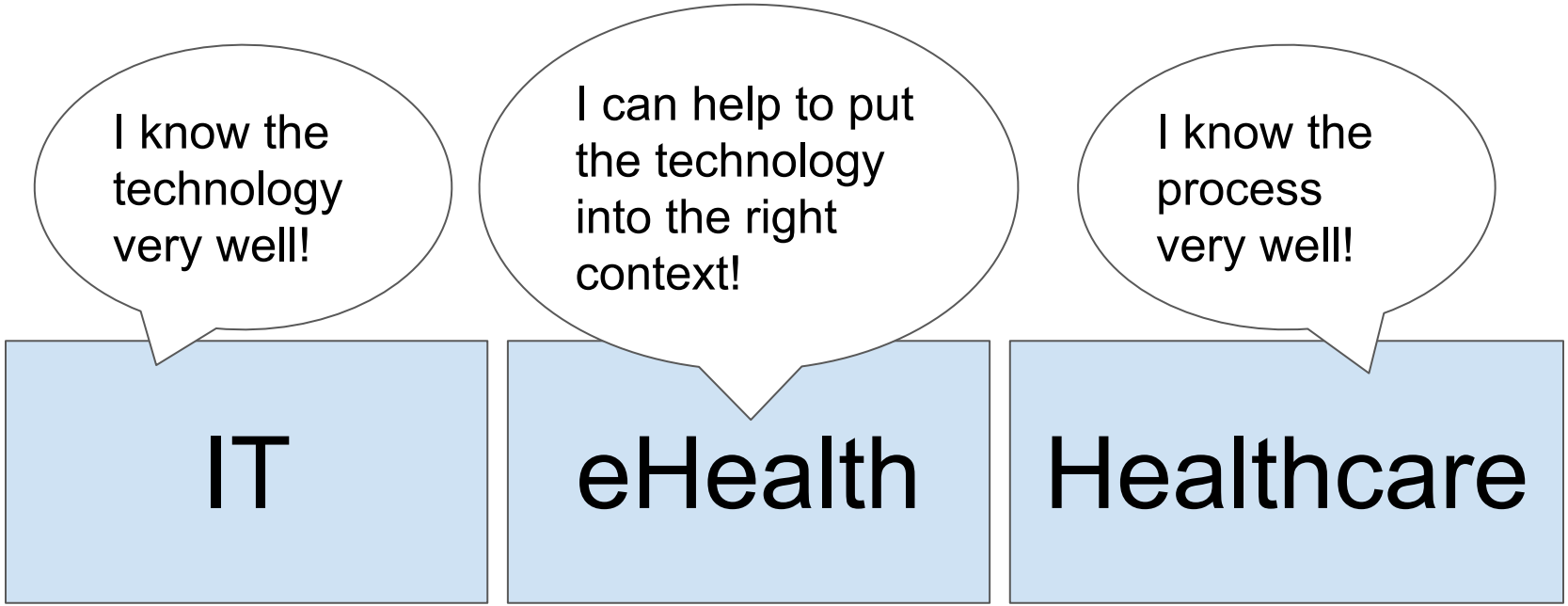
TAL TECH

Sharing paradigms

	Governance	Agility	Secondary use	Coordination
Reactive Sharing	Combined (Confederative, Matrix)	High	Dynamic	Distributed
Registry Sharing	Monopoly, Multi-poly, Federative	Low	Static	Central
Document Sharing	Bilateral, Multilateral	Medium	Manual	Manual

TAL TECH

eHealth is still a very valid field of research



DIGITAL HEALTH STUDIES ARE FREE FOR EU STUDENTS

Apply now: https://www.taltech.ee/en/hct

DIGITAL HEALTH (MSc, PhD)

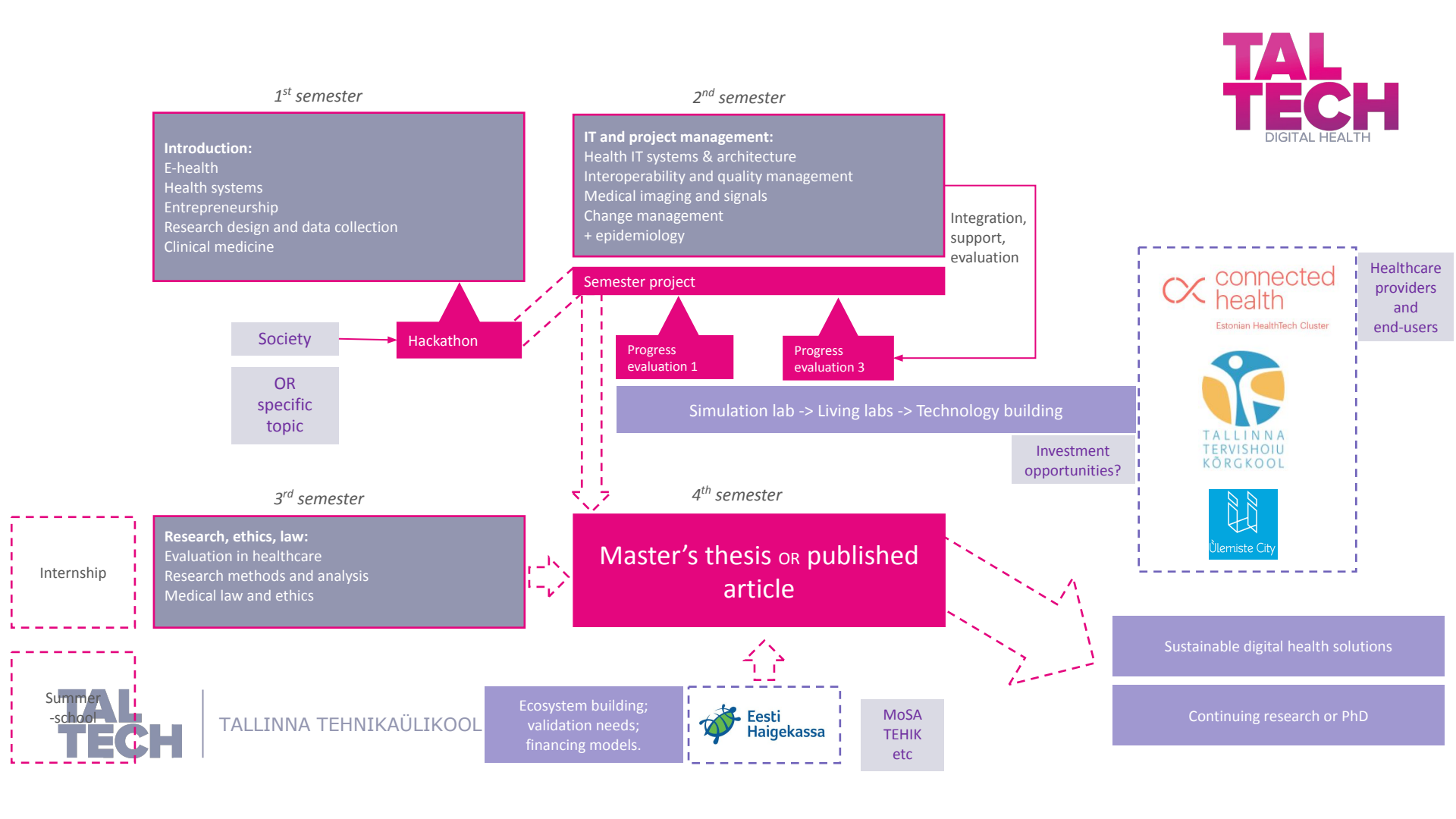
School of IT
Tallinn University of Technology

Graduates should understand how medicine, IT and health care **interact**.

Be able to gather specialized knowledge and skills how to interpret that knowledge in critical, analytical and creative manner

…in order to contribute to changes improving healthcare, either at health care service providers, public or private sector organizations.

FUTURE CHANGE MANAGERS OF HEALTHCARE


TAL TECH
DIGITAL HEALTH
1st semester
Introduction:
E-health
Health systems
Entrepreneurship
Research design and data collection
Clinical medicine
2nd semester
IT and project management:
Health IT systems & architecture
Interoperability and quality management
Medical imaging and signals
Change management
+ epidemiology
Integration, support, evaluation
Semester project
Society
OR specific topic
Hackathon
Progress evaluation 1
Progress evaluation 3
Simulation lab -> Living labs -> Technology building
Investment opportunities?
connected health
Estonian HealthTech Cluster
TALLINNA TERVISHOIU KÕRGKOOL
Ülemiste City
Healthcare providers and end-users
3rd semester
Research, ethics, law:
Evaluation in healthcare
Research methods and analysis
Medical law and ethics
4th semester
Master's thesis OR published article
Internship
Summer -school
TAL TECH
TALLINNA TEHNIKAÜLIKOOL
Ecosystem building; validation needs; financing models.
Eesti Haigekassa
MoSA
TEHIK
etc
Sustainable digital health solutions
Continuing research or PhD

TALTECH DIGITAL HEALTH (MSc, PhD)

- First students enrolled in 2009
- School of Information Technologies
- Main source of information: https://taltech.ee/en/hct

Program Director: Priit Kruus: kadi.lubi@taltech.ee

Program Assistant: Signe Bergert signe.bergert@taltech.ee

Lead professor: Prof Peeter Ross, MD, PhD peeter.ross@taltech.ee

Community manager: Helen Staak helen.staak@taltech.ee

janek.metsallik@taltech.ee
School of IT
eMed Lab / Digital Health MSc programme
Tallinn University of Technology