

Resilient Healthcare by IT support

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Introduction



- To be ready for unexpected incidents of pandemic or paramedic situations in developing countries
- Because these situations will affect and be spread globally to all over the world.
- In this presentation, we propose a resilient health care approach utilizing several IT technologies.
- IT technologies are statistical analysis, process mining, and finally AI based analysis.

Rise of Resilient Systems and engineering

- Resilient Systems and Engineering has been started since early 21st centuries.
- The objective of the systems and engineering is how we can manage both predictable and unpredictable incidents in social activities.
- Based on unpredictable incidents like Tsunami we Japanese experienced,
- Japan has more paid attention to Resilient Systems concept
- The system can be capable even unexpected disaster incidents may occur in the future.

The requirement for Resilient Healthcare in developing countries

- Resilient Healthcare is one of resilient systems
- predicted and unpredicted medical incidents and processes are the problem domain.
- In developing countries, resilient healthcare is very important
- pandemics or severe paramedic situations may occur
- these threats are not only for the original countries but also may be big threats for rest of the world.
- we propose ITU-D, how we can manage these threats by applying resilient healthcare systems.

There two levels of resilient safeties:

Safety-1: (Avoid failure processes, and keep successful processes)

- Key principle of Resilient Healthcare is “to keep the successful processes as much as possible”, rather “to salvage failure processes” and avoid failure processes.

Safety-2: (Predictive safety management)

- The activities are coordinated to keep the processes to be succeed than to be failed by the human experts’ efforts, and predictive safety management is required.

Three Phase approach



- First phase
- Gather several predicted and unpredicted examples in the past healthcare facts from every ITU-D related countries
- Data will be formalized to be a resilient example database.
- How we can set up anonymity is the challenge at this stage.
- Second phase
- Analyze explicit and implicit processes in these descriptions, by manually and semi automatically as possible.
- Third phase
- Introduce statistical analysis, process mining utilizing machine learning such as temporal deep learning technologies to analyze both explicit and hidden processes in the database.
- Find what aspects will be the key feature for resilient healthcare
- Automatic prediction and unexpected process discoveries.

Three Phase approach

- First phase
 1. Gather several predicted and unpredicted examples in the past healthcare facts from every ITU-D related countries
 2. Data will be formalized to be a resilient example database.
 3. How we can set up anonymity is the challenge at this stage.

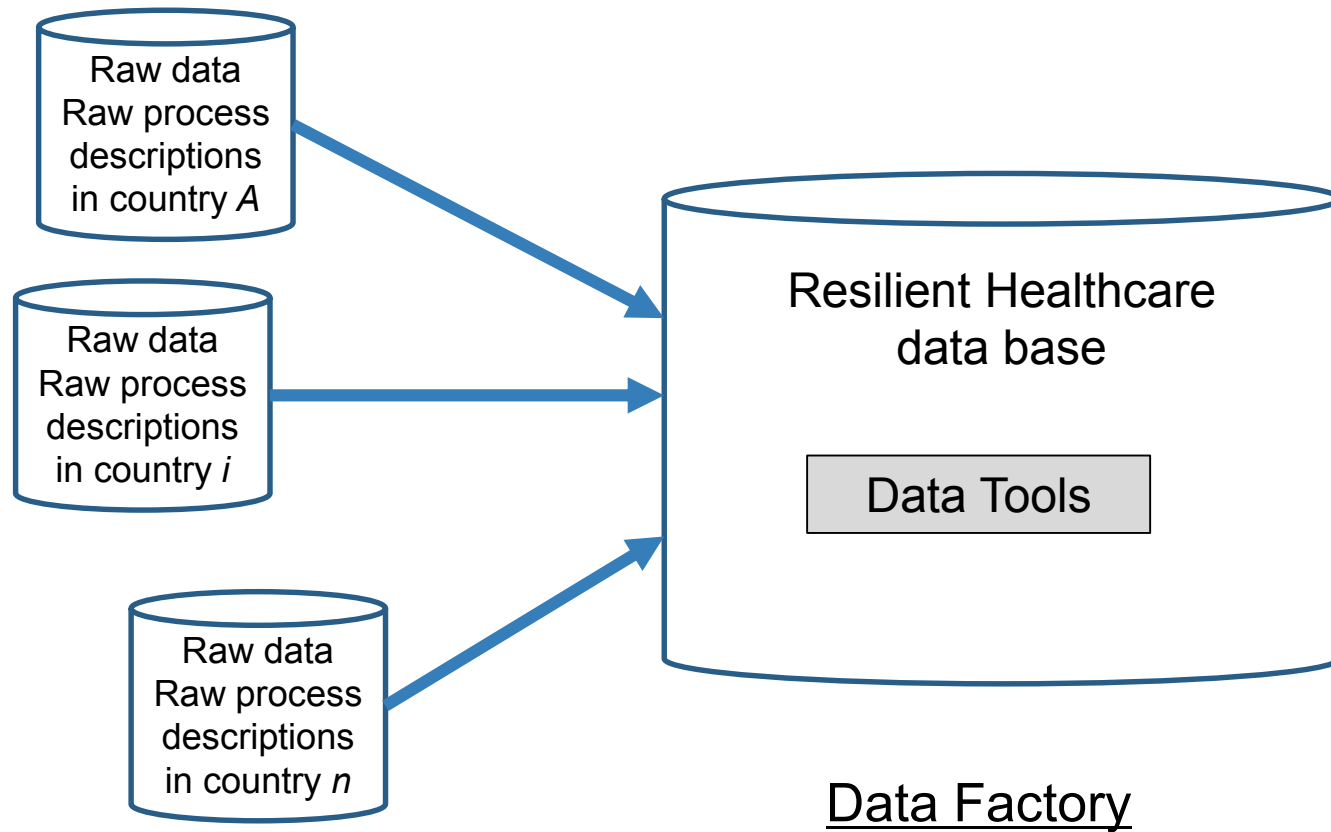


Fig1. Phase1: Gathering Text Information

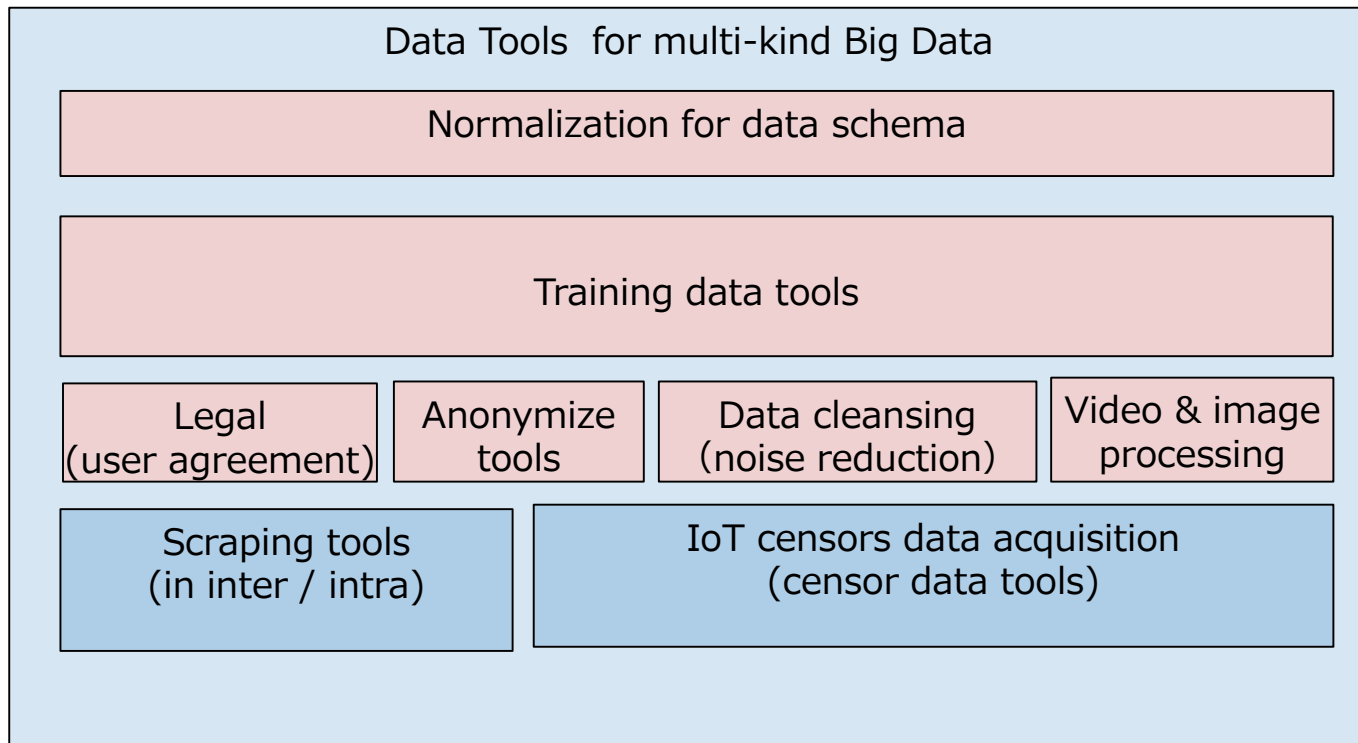


Fig2. Phase1: data tools

Three Phase approach

- Second phase
- Analyze explicit and implicit processes in these descriptions, by manually and semi automatically as possible.

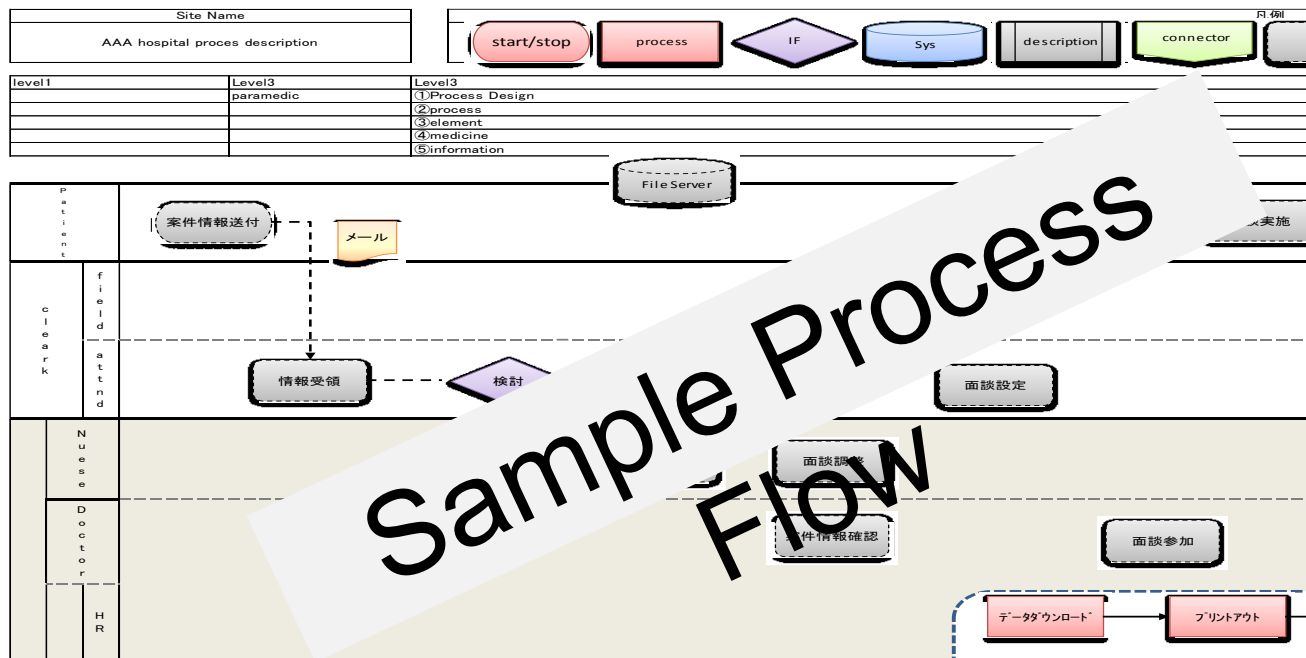
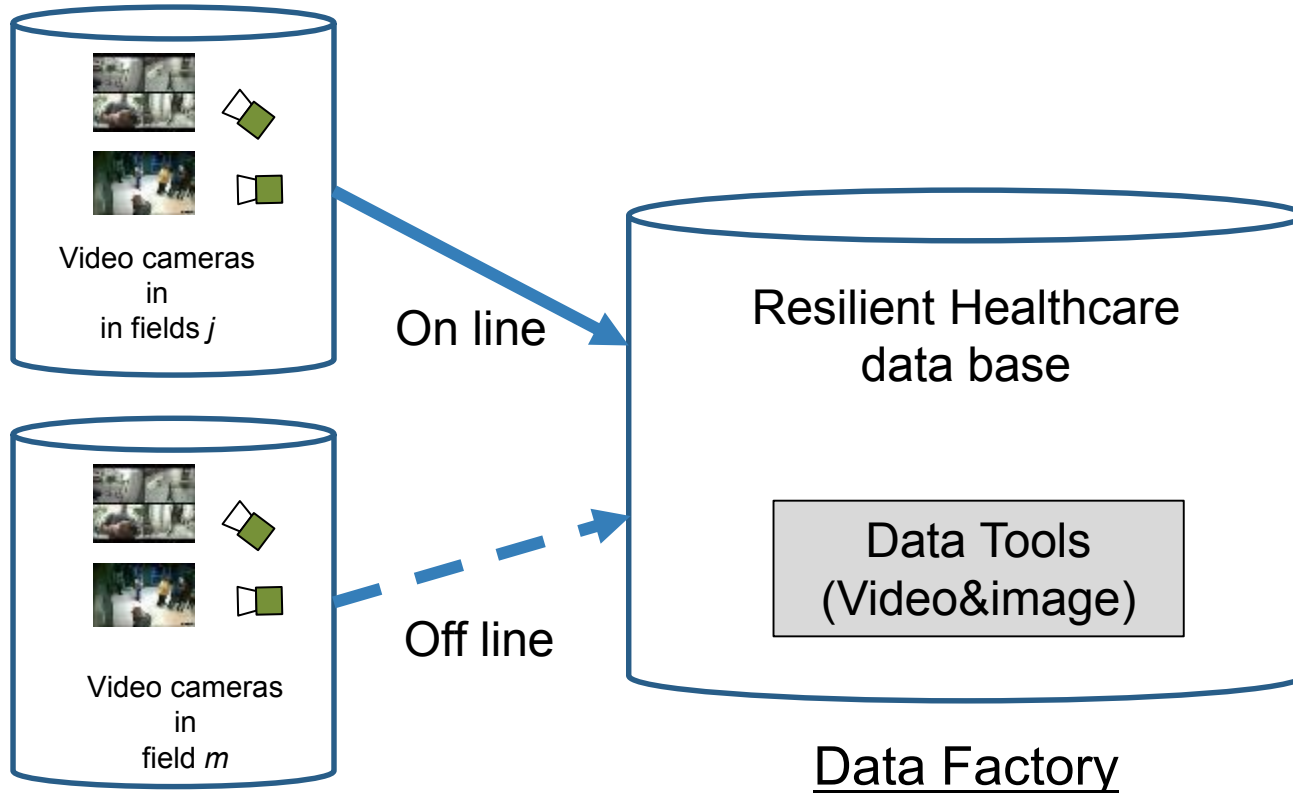


Fig4. Phase2: Process Description



Video in fields (airports, hospitals, etc.)
(Existing security cameras can be used)

Fig3. Phase1: Video in the fields

Three Phase approach



- Third phase
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 2. Find what aspects will be the key feature for resilient healthcare
 3. Automatic prediction and unexpected process discoveries.

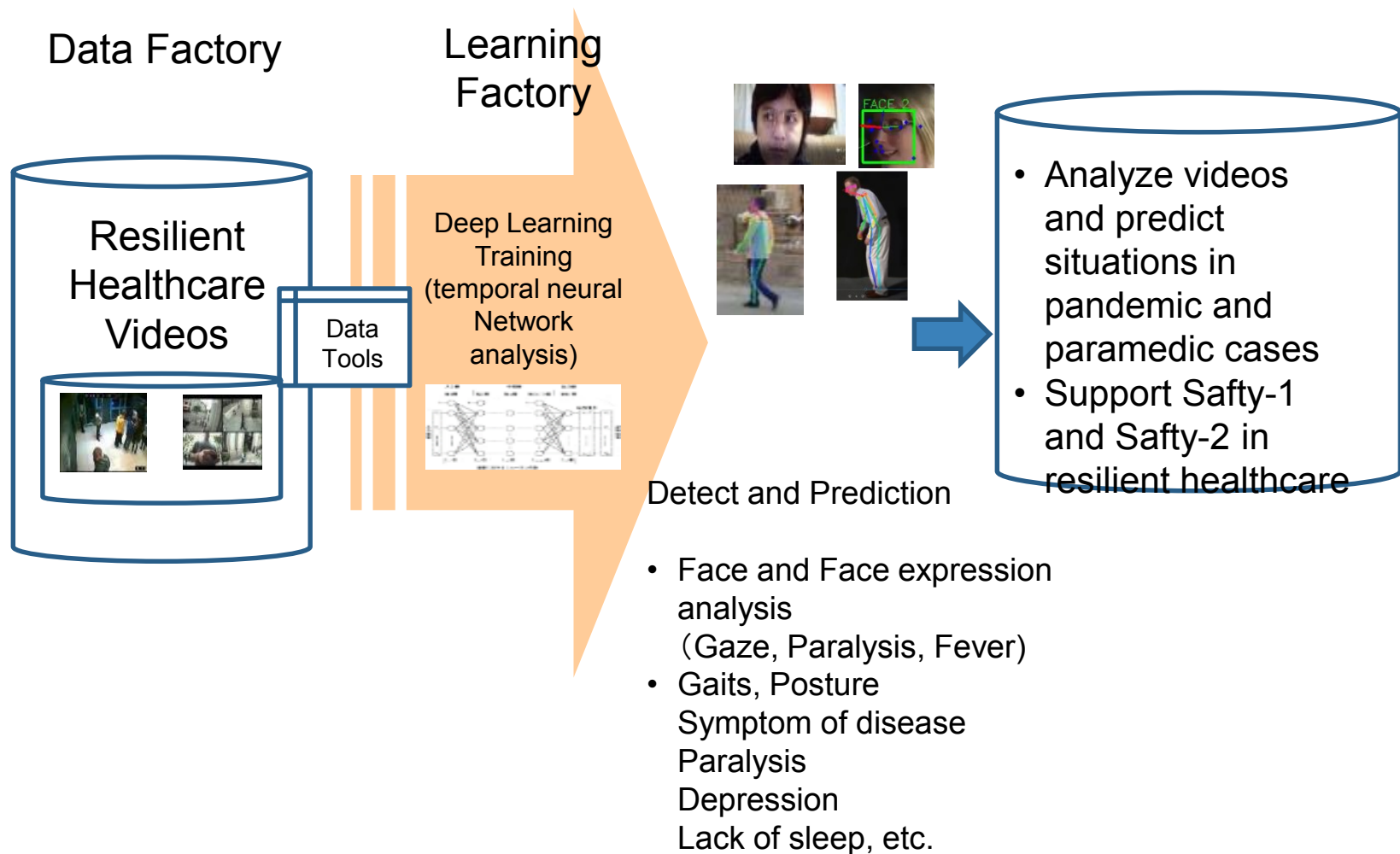


Fig5. Phase3: AI processing for video data

Medical application1 : Rehabilitation

- Take videos for patients and analyze the status
- Manage past videos then propose and how to do rehabilitation
- This can be applied to sport rehabilitation too



Analyze a person who is parallelized left hand side

Discussions and further issues

- **How we can find hidden processes in resilient operations**
- Multi-disciplinary approach is needed

Process Mining

- Process Mining is still in more research phase than the other technologies (machine learning and deep learning).
- But through this proposed activity, many resilient processes are gathered and well manually described in phase 1 and 2
- this condition will give chances to apply deep learning technology (especially temporal deep learning technology, such as RNN, LSTM etc.
- to process mining, as generally deep leaning needs more trained data for its better learning.

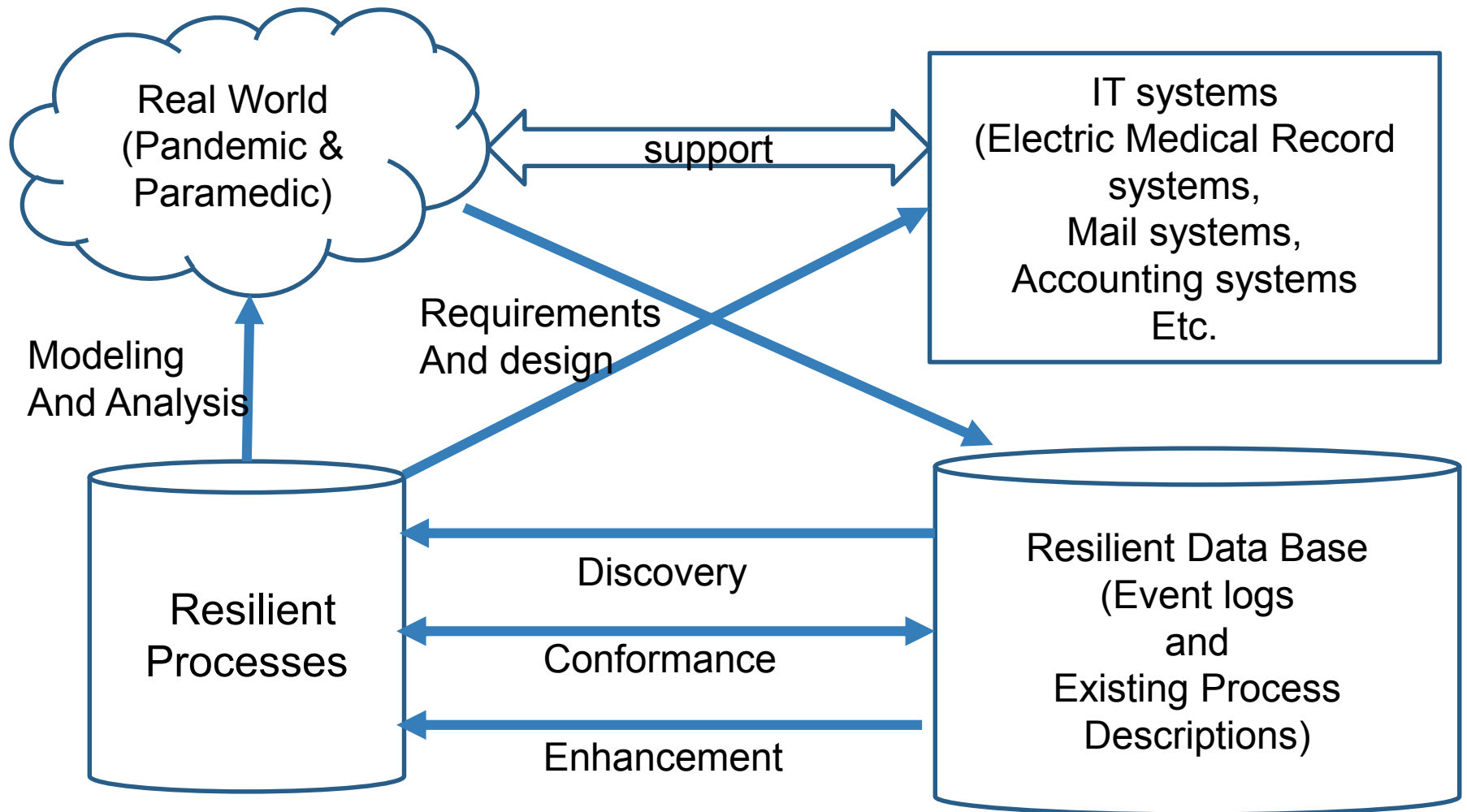
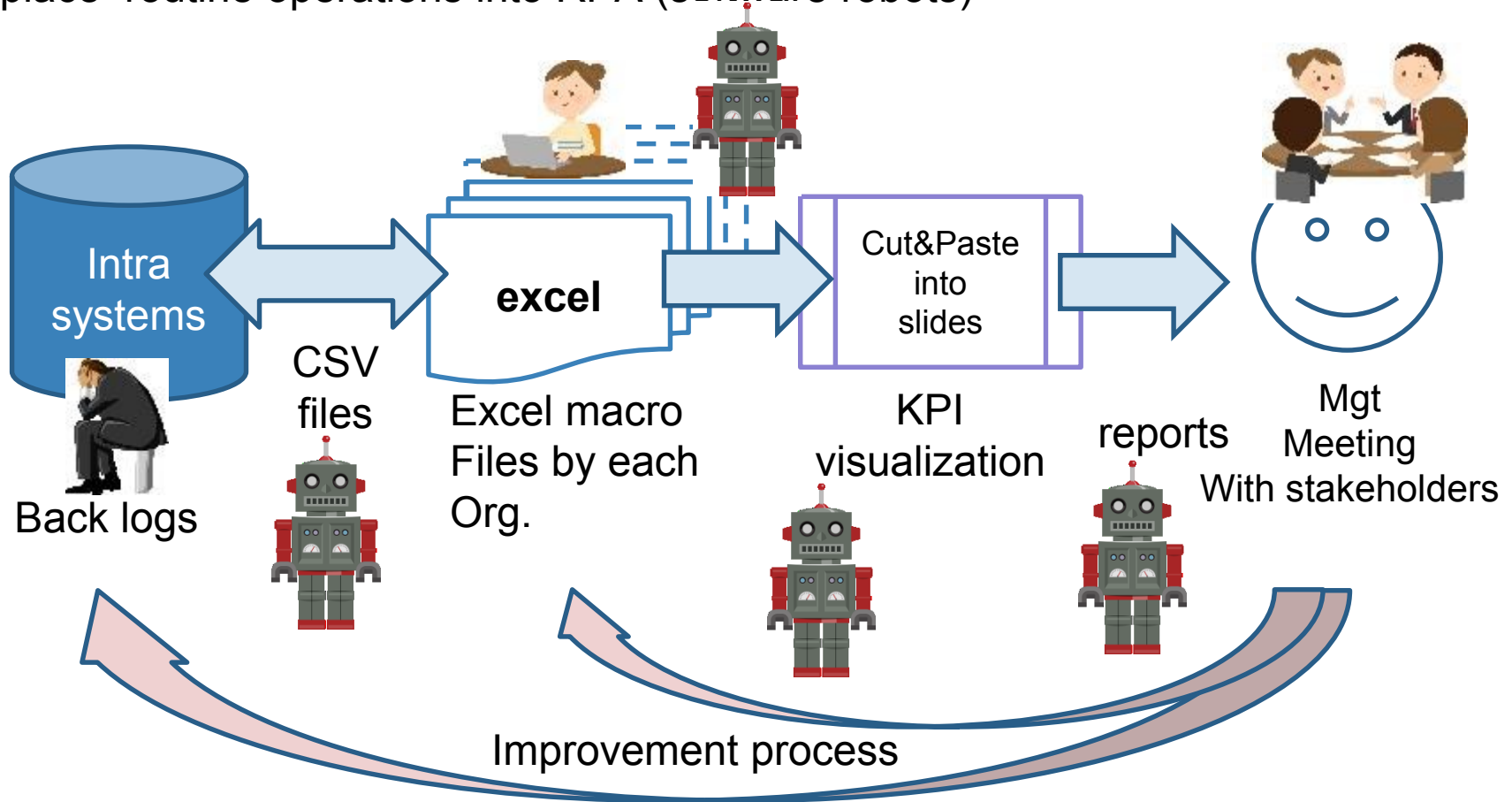


Fig6. Process Mining in Resilient healthcare

Ref) Replace Routine works into office software robots

Ex) monthly review support with RPA (Robotic Process Automation) :

- Every month, people have to create KPI graph from several fragments of excels which are downloaded by un-flexible intra-web systems
- Replace routine operations into RPA (software robots)



Discussions and further issues

How we can find hidden processes
in resilient operations

**Multi-disciplinary approach is
needed**

5. Consultation for AI/IoT & Data Science

1. Domain Knowledge

- Healthcare
- Data Source
- Semantics of Data
- Legal

2. Resilient Engineering

- Process description
- Safty-1
- Safty2

3. Data Science

- Data Model
- Analytics Framework
- Statistical model
- Machine Learning
- Deep Learning

4. Systems Architecture

- Building System Architecture
- Rapid Dashboard

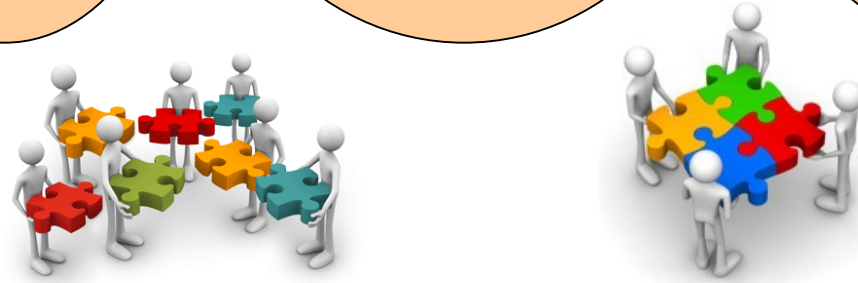


Fig7: Multi-Disciplinary Business Architecture

Conclusion



We proposed following phases

- Phase1: Gathering process data to analyse resilient healthcare in daily activities.
- Phase2: Describe both successful processes and failure processes
- Phase3: Analyze described processes, discover hidden processes, and predict critical processes

According to these phases, we will be able to support resilient healthcare to be more systematic and semi-automatic manner.

We would like to invite ITU-D related organizations to join this proposed activity.

Appendix

Application 3: support elders

- Take videos for paralyzed elder patients and support
- Quantize the paralysis by wireframe
- Feedback them to doctors, patients and family



High level
analysis

Feed back to
Patients,
elders

Wireframe model analysis to video

High level analysis is subscribed
as patent from OrangeTechLab

Gaits Analytics Systems Image

- Subscription biz models for several gaits, posture, action analysis -

