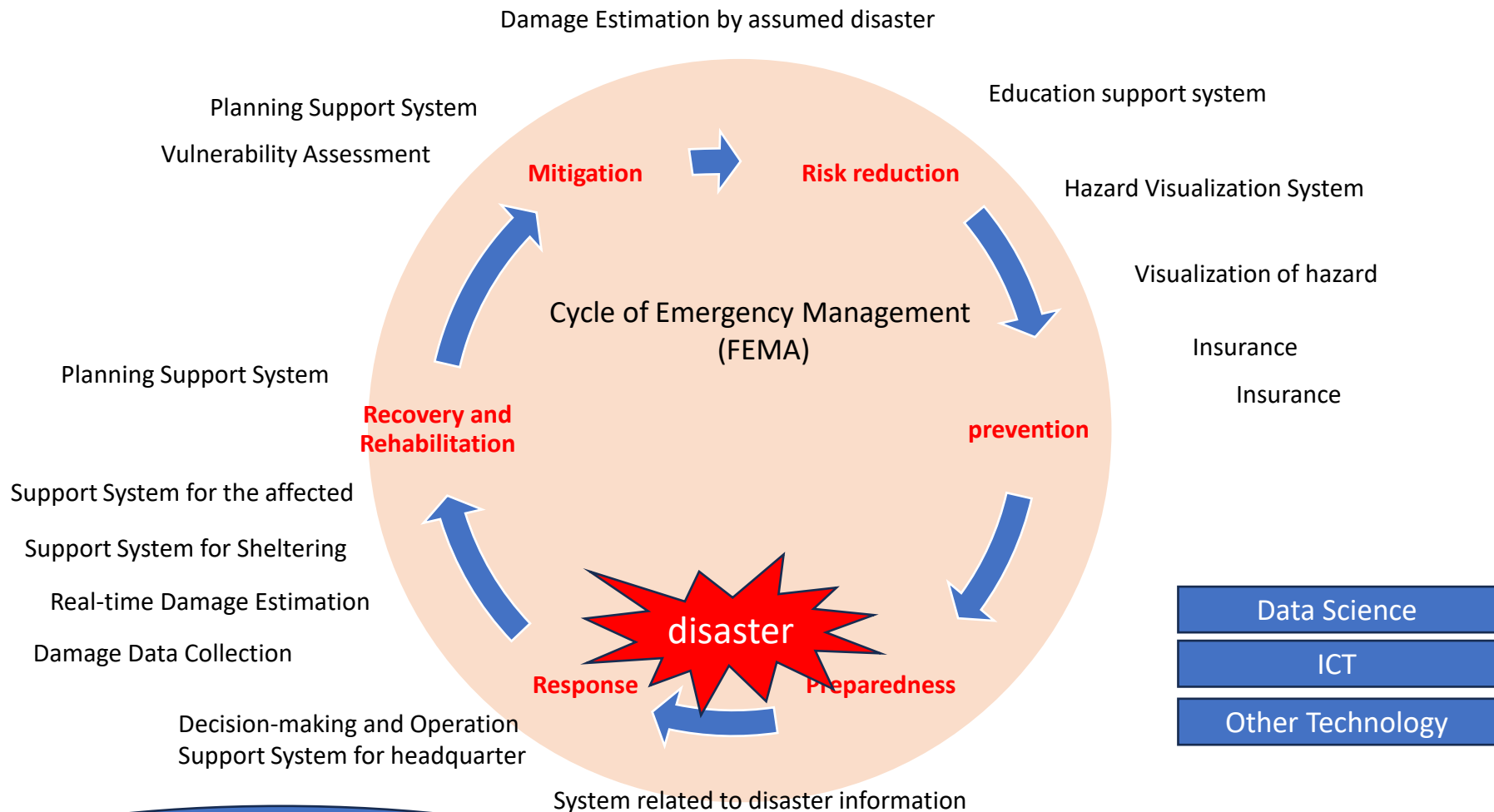


Digital Transformation for Disaster Management



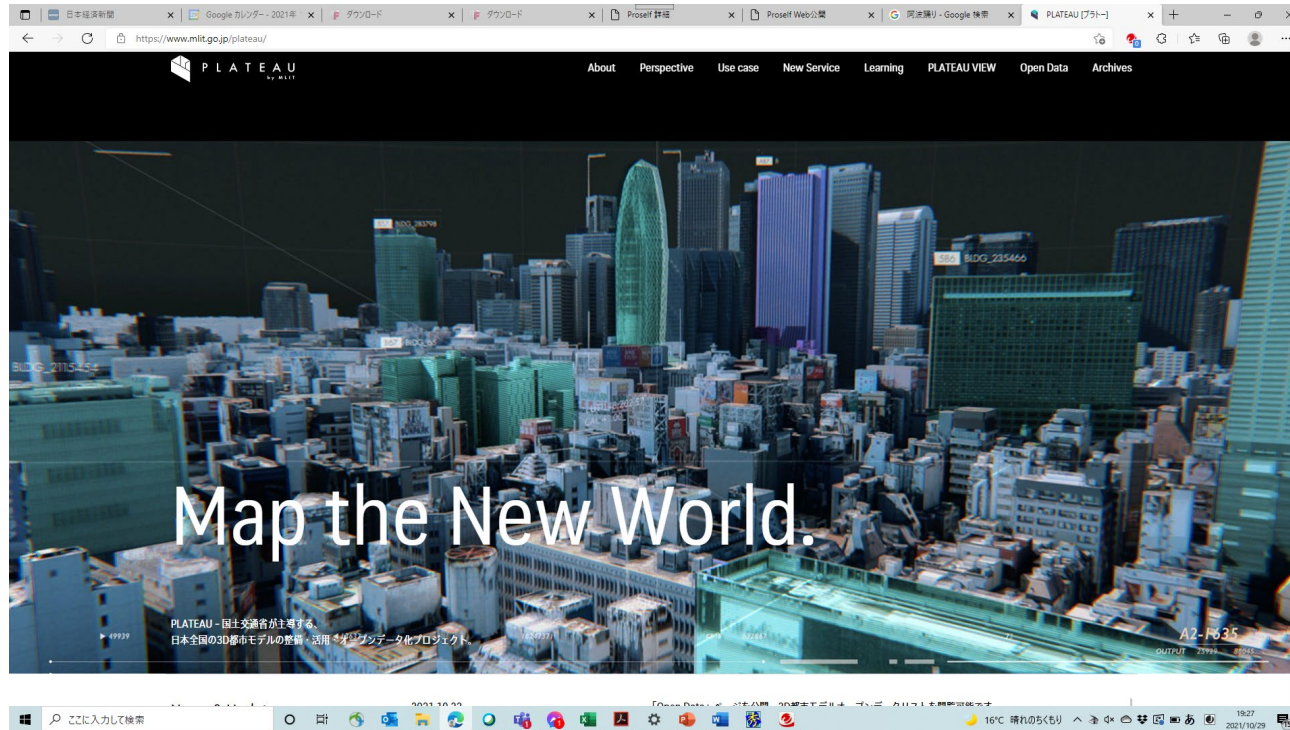
Important Keywords:
Society5.0, DX, **Digital Twin**,
Smart City,

Takaaki KATO

Institute of Industrial Science, the University of Tokyo
Professor, Institute of Social Science, the University of Tokyo
(Regional Planning, Disaster Management, Social Safe System)

Prospects for digital twin in cities and regions

Society5.0, DX, Digital Twin, Smart City,



Takaaki KATO

Professor, Institute of Industrial Science, the University of Tokyo

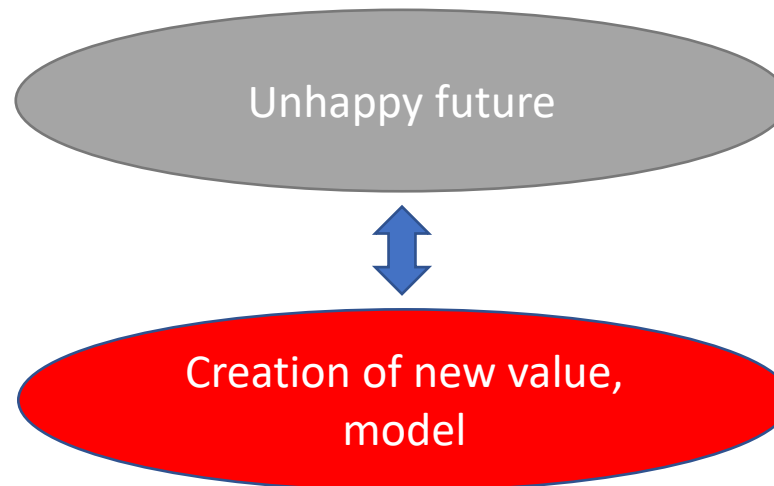
Project Professor, Institute of Social Science, the University of Tokyo

(Urban and Regional Planning, Disaster Management, Social Safe System)

Undesirable future of **Society 5.0**

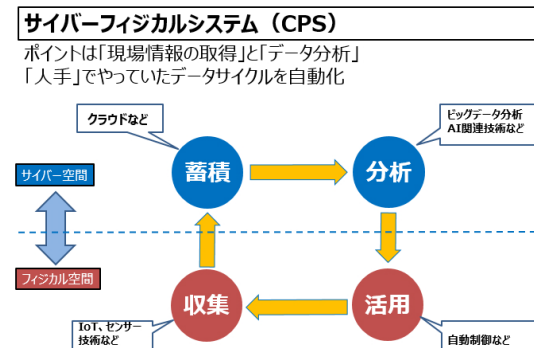
Hunting-based society (1.0) → Agriculture-based society (2.0) → Industrial society (3.0) → Information society (4.0)

- There are many social issues such as the declining birthrate and decreasing productive population. This is especially serious in regional cities. Due to the lack of people, even the bare minimum of work to maintain the area, including infrastructure maintenance, is difficult.
- DX regions and digital twins for cities and have saved labor and helped address the labor shortage.
- 少子化, 生産人口減等, 社会課題が山積している. 特に地方都市では深刻である. 人出不足によって, インフラのメンテナンス含め, 地域維持のための最低限の仕事すら困難である.
- DXや都市・地域のデジタルツインによって作業が省力化され, 人手不足に対応することができた.



What is a digital twin?

- General definition:
 - “Twins in digital space”. "Technical concept of collecting objects and environmental conditions in real space and copying and reproducing them in digital space"
- In the fields of Engineering:
 - Optimization of Design (CAE (Computer Aided Engineering))
 - ➡ Optimization of manufacturing processes (accident prevention) ➡ Creation of new services



- Target fields of digital twin in urban and regional plan and disaster management:
 - **Disaster Management, urban development**, mobility, energy, nature, wellness, education, work style, industry—



What is a **digital twin**?

- Digital twin has two meaning: twin and digital

- The significance of twin: Considering from concept of analog twin

- **Significance of digital**

1. Visualization

- Category 1: Visualization of things that are visible but difficult to understand.
- Category 2: Visualization of things that exist but cannot be seen.
- Category 3: Visualization of things that are invisible inherently such as functions and performance

2. Real-time Monitoring

3. Simulation

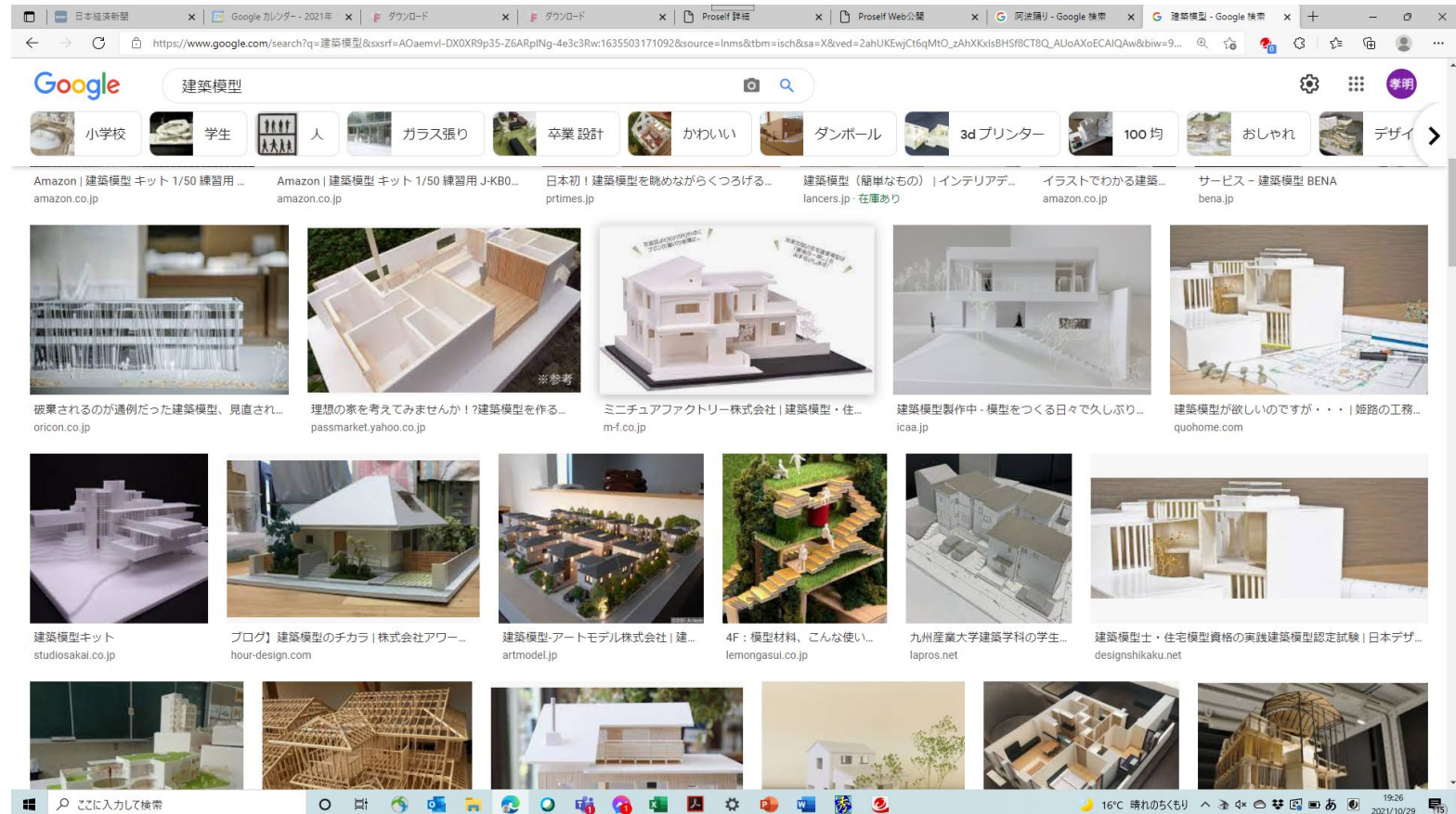
4. Mashed-up visualization of many kinds of data

5. Creation of new value

- A place where AI grows

What is a digital twin? : Considering from the perspective of analog twins デジタルツインとは? : ツインの意義 : アナログツインから考える

architectural model



- We can check from various angles and refine design with a model.

What is a digital twin? : Considering from the concept of analog twins

- Apollo 13 was launched on April 11, 1970 at 13:13 CT, aiming to become the third manned mission to the moon.
- Two days later, an accident occurred: a short circuit in the electrical wires caused a spark which caused the oxygen tank in machine room to explode. Severe power and water shortages occurred.
- It was safely returned to Earth through making power consumption reduce to the limit
- It was praised as a "successful failure" and a "glorious failure".



Real world
in space



analog twin

control room
on the earth



What is a digital twin?

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What is a digital twin? : Significance of digital

- Visualization: category 1
 - Visualization what is visible but difficult to understand.
- Digital can visualize of things that cannot be seen spatiotemporally as whole image
- Examples:
 - People-flow data
 - Airplane location data



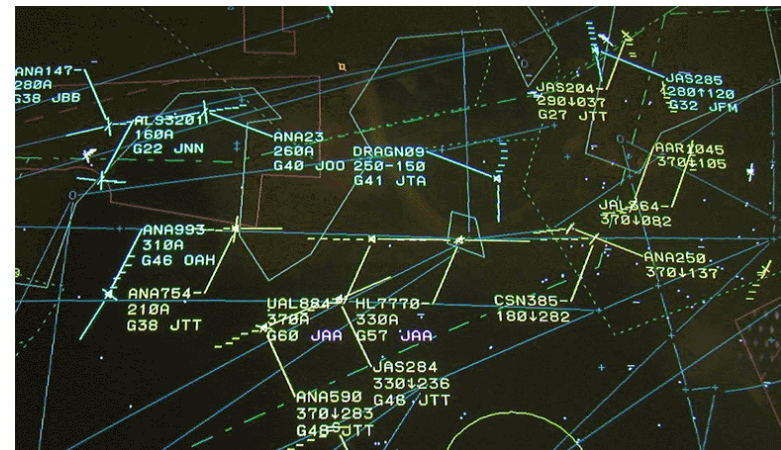
Shibuya ward before the coronavirus pandemic as an example of People-flow analysis

<https://www.unerry.co.jp/service/activity-data-visualization/>



Haneda airport control tower

<https://www.yasui-archi.co.jp/factbook/design13.html>

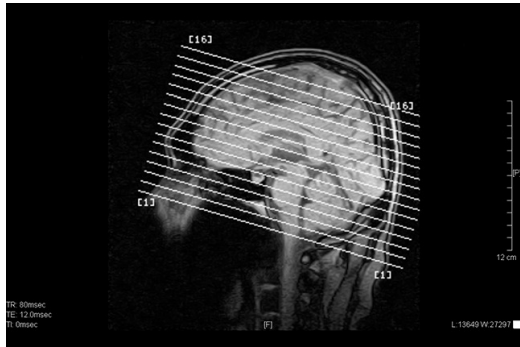


Display Image of Traffic Control support system for airplane

https://www.mlit.go.jp/koku/15_bf_000333.html

What is a digital twin? : Significance of digital

- Visualization: category 2
 - Visualization of things that exist there but cannot be seen.
- Example:
 - Visualization of inside the skull for brain surgery
 - Infrastructure under the ground



MRI検査で何がわかる？ CT検査との違いや発見できる疾患 - 人間ドックなび (docknet.jp)
<https://www.docknet.jp/media/brain-dock-13/>



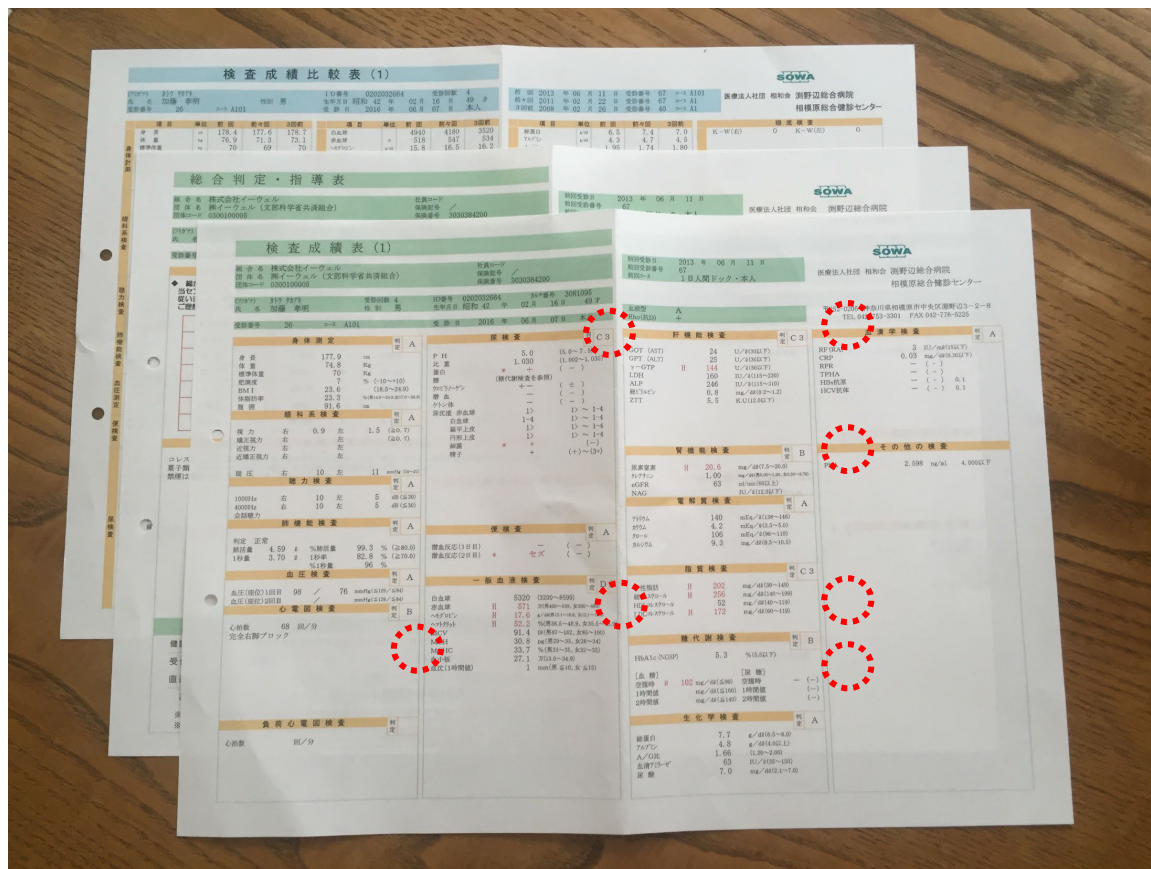
地下埋設物の位置情報を3次元で可視化する技術 地上・地下インフラ3Dマップ | 大田区中小企業 新製品・新技術コンクール 受賞企業紹介 | 公益財団法人大田区産業振興協会 (pio-ota.jp)
https://www.pio-ota.jp/concours/c31/3_3d.html



地下埋設物可視化システム | 技術・ソリューション | 清水建設 (shimz.co.jp)
<https://www.shimz.co.jp/solution/tech343/index.html>

What is a digital twin? : Significance of digital

- Visualization: category 3
 - Visualization of things that are invisible inherently such as functions and performance



My medical check

How can we do medical check for a city and region?

– Medical field has many kinds of diagnose tools such as stethoscope, ultra sonic wave, X-ray, CT scan, and MRT,

shidukuri.pdf | 先端医療機器 - Go | NHKスペシャル | 震災 | NHKスペシャル | 不燃領域率 - Google | 20140728_95BD90AC2 | さいたま市／防災都市 | Grene-City Project: 東京

google.co.jp/search?q=%E5%85%B8%E7%AB%AF%E5%8C%BB%E7%99%82%E6%A9%9F%E5%99%A8&biw=1600&bih=738&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjWr8Wu-87NAhVeo5C

matsu-t@iis.u-tokyo.ac.jp | 検索結果がありません | オプション

先端医療機器

すべて ニュース 地図 画像 ショッピング もっと見る 検索ツール

セーフサーチ

We should develop more tools with higher performance for medical check of a city and region.

医療の最

最先端医療機器のもののつくりを極める、製造の匠

とWindowsを検索

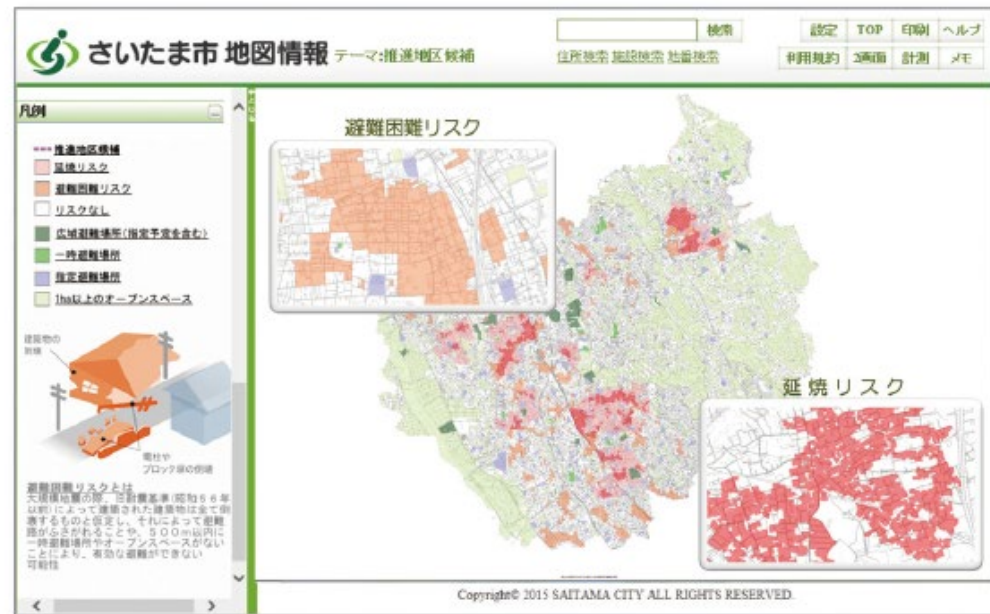
14:55 2016/07/01



Assessment tool for vulnerability to urban fire spreading in post-earthquake
by fire-spreading cluster named by T. Kato(2006)

Saitama city earthquake disaster damage risk check system based on GIS

さいたま市:防災都市づくり計画、GISベースのリアルタイムの災害リスクモニタリングシステム



■GIS(※) による災害リスクのモニタリング

Risk Check system based on GIS in Urban Planning Division of Saitama City



Hazard
+
Building data linked with the Property Tax Ledger
(Check once a year)

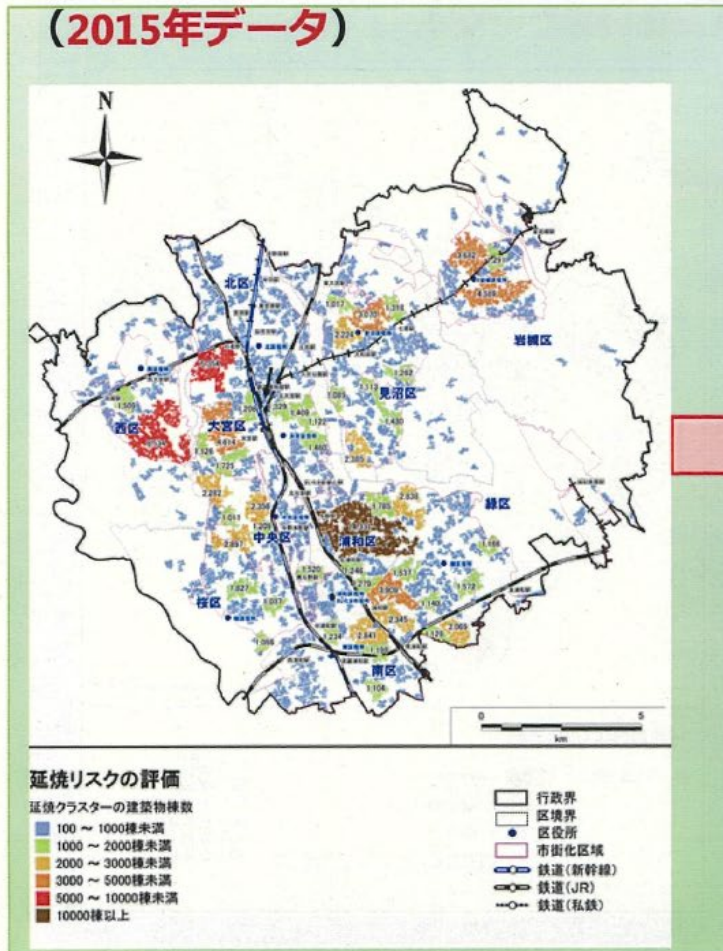
Result of risk check about urban fire-spreading (2015-2016)

延焼リスクの変化の傾向 (2015→2016)

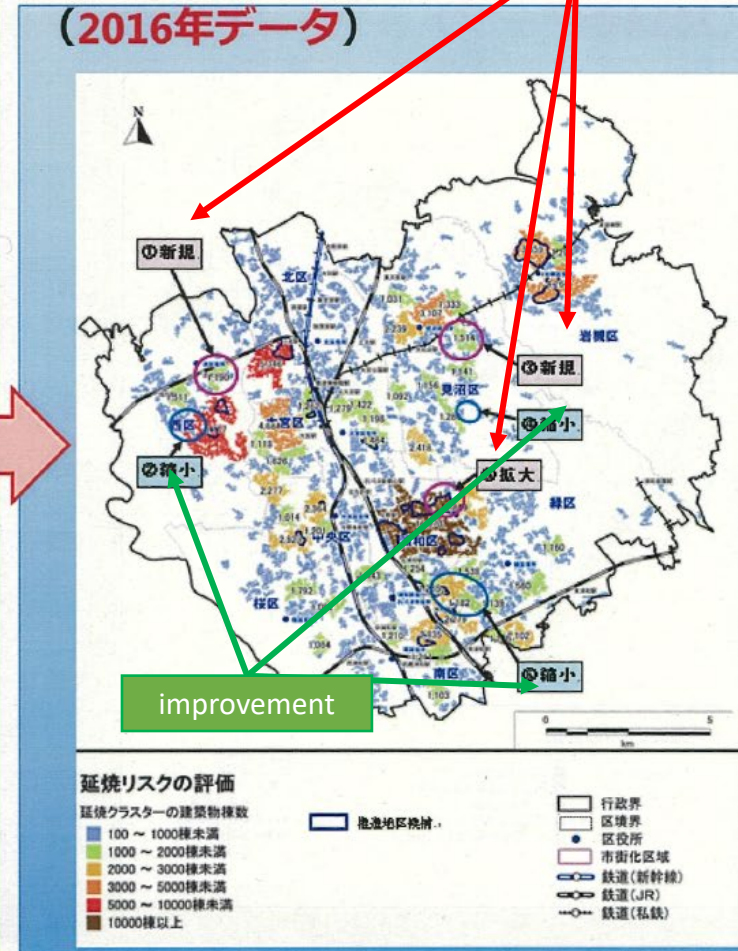


【延焼リスク】

(2015年データ)



(2016年データ)



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What is a digital twin? : Significance of digital

- Real-time monitoring is necessary for every decision-making

The image is a collage illustrating the concept of digital twins and real-time monitoring. It features several key elements:

- Google Search Results:** A screenshot of a Google search for "ウェアラブルデバイス 医療機器" (Wearable devices medical equipment). The results show various articles and images related to wearable medical devices, including a heart rate monitor and a smartwatch.
- 3D City Model:** A 3D rendering of a city skyline, likely Tokyo, with the text "Map the New World." overlaid. This represents a digital twin of a physical environment.
- Heatmap Map:** A detailed map of the Tokyo subway system with heatmaps overlaid, showing areas of high activity or density. This represents real-time monitoring of a complex system.
- Wearable Devices:** Images of various wearable medical devices, including a heart rate monitor, a smartwatch, and a small sensor, illustrating the hardware used in digital twin applications.
- Business Insider Article:** A snippet from Business Insider titled "WEARABLE TECH IN 15 hrs/week" and "13 disease-related findings", highlighting the impact of wearable technology on healthcare.

The bottom of the image shows a Windows taskbar with various application icons and a system clock indicating 11:34 on 2021/11/01.

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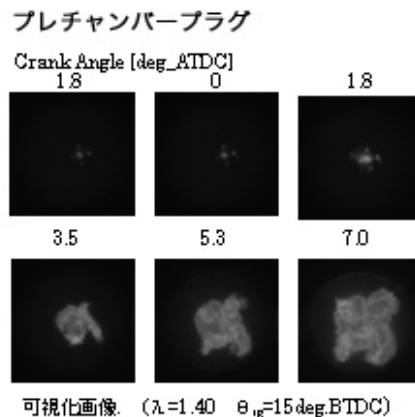
What is a digital twin? : Significance of digital

- Simulation

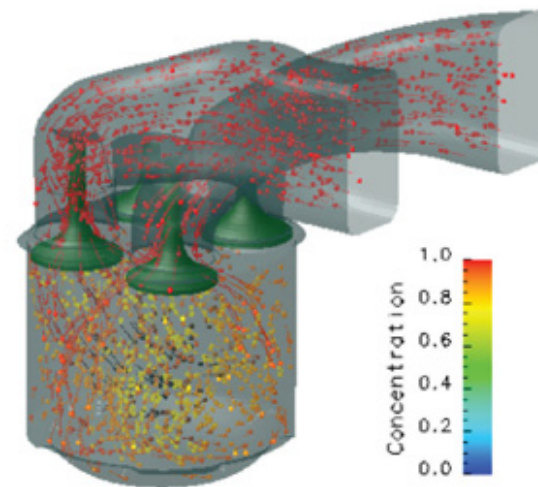
- It should not only save labor in prototyping and experimentation, but also contributes to create something new.
- Innovation of simulation technology is required.

- シミュレーション

- 試作・実験の省力化にとどまらず，新たな創造.
- シミュレーションの革新・複合化

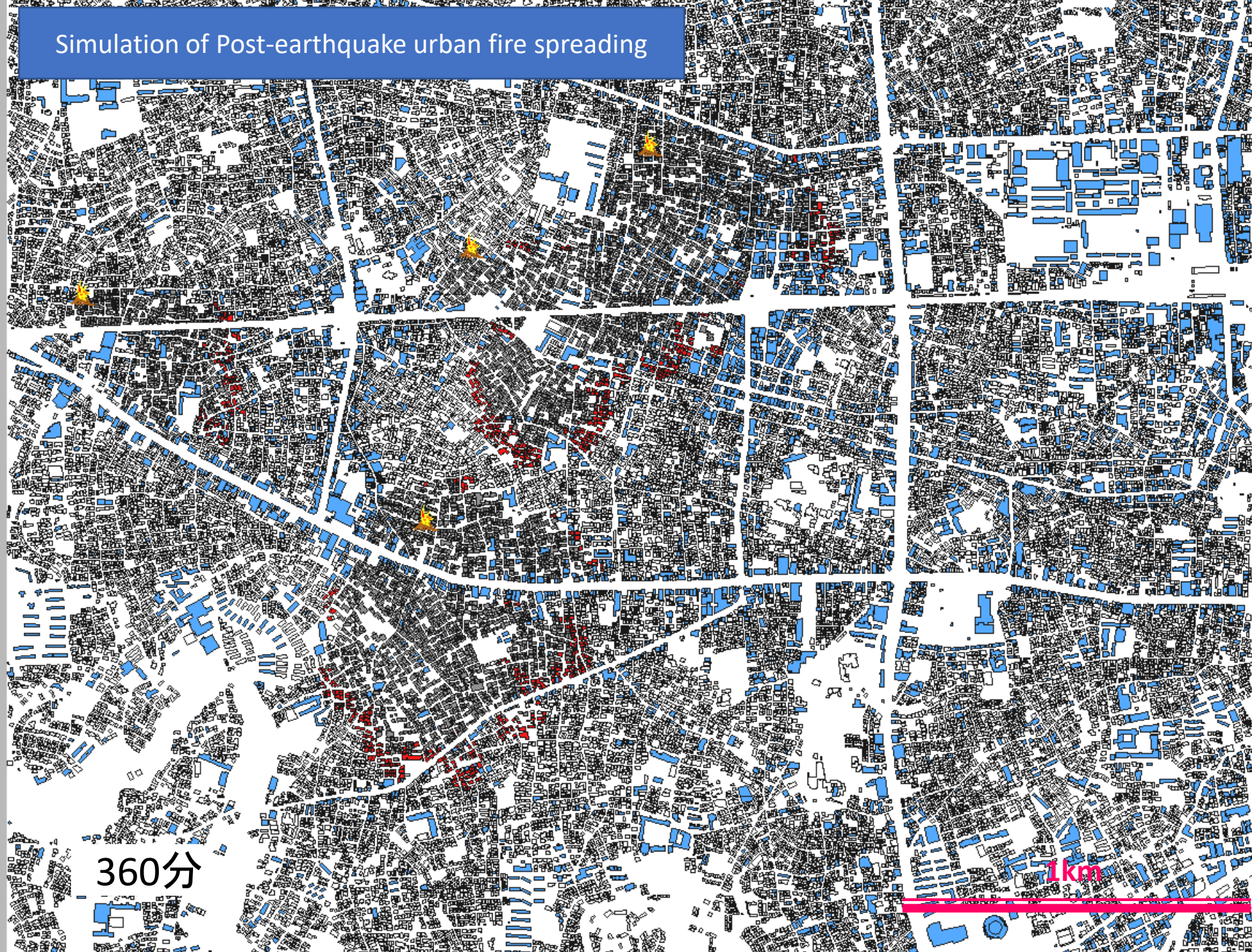


可視化エンジン試験結果



シミュレーション解析例

Simulation of Post-earthquake urban fire spreading



Evacuation simulation combined with urban fire-spreading simulation

The university of Tokyo
Kozo keikaku engineering inc.

Suginami city with one million of
population

Assumption

- Number of fire breakpoint: Estimatable maximum numbers
- called well-behaved model
- etc.

Moreover, it should be combined with real-time monitoring in the future.

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- Mashed-up visualization of many kinds of data
 - 1+1>2 Creating synergies

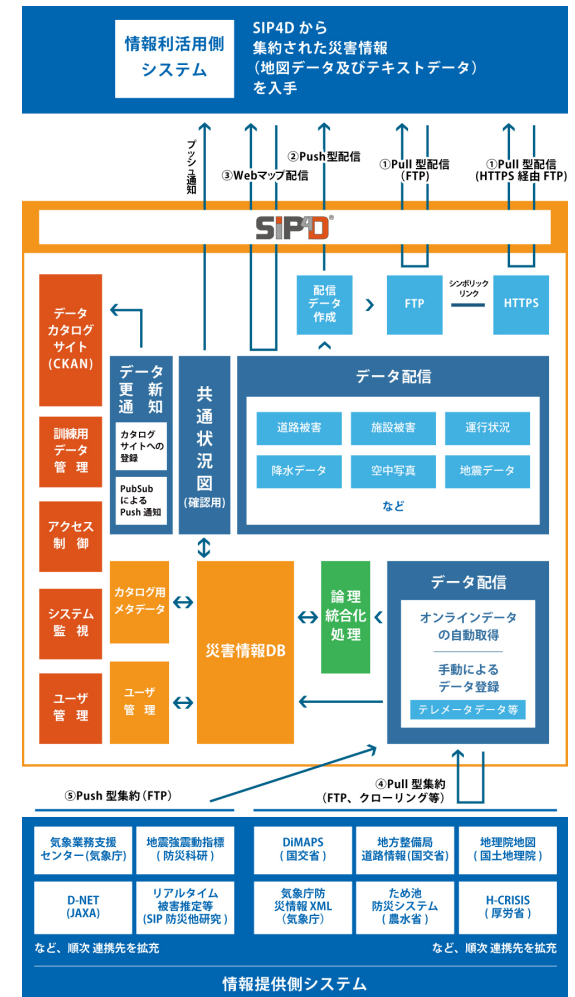
防災情報マッシュアップサービス (GDMS)

GITA-JAPAN (GEOSPATIAL INFORMATION & TECHNOLOGY ASSOCIATION) が行っている、災害復旧活動の最適化支援のための、情報共有プラットフォーム構築の取り組みに参加しています。

GIS技術を活用したエリアや組織を横断的に情報共有可能な空間情報基盤として、各機関の防災・被災・復旧情報の情報共有プラットフォームを構築し、災害・復旧時での住民や関係企業・ボランティア等への総合的な情報提供・情報共有を可能とすることで、防災・災害復旧支援活動に寄与することを目的としています。



Geospatial mash-up service for related Information to disaster by
GITA-JAPAN (~2011)



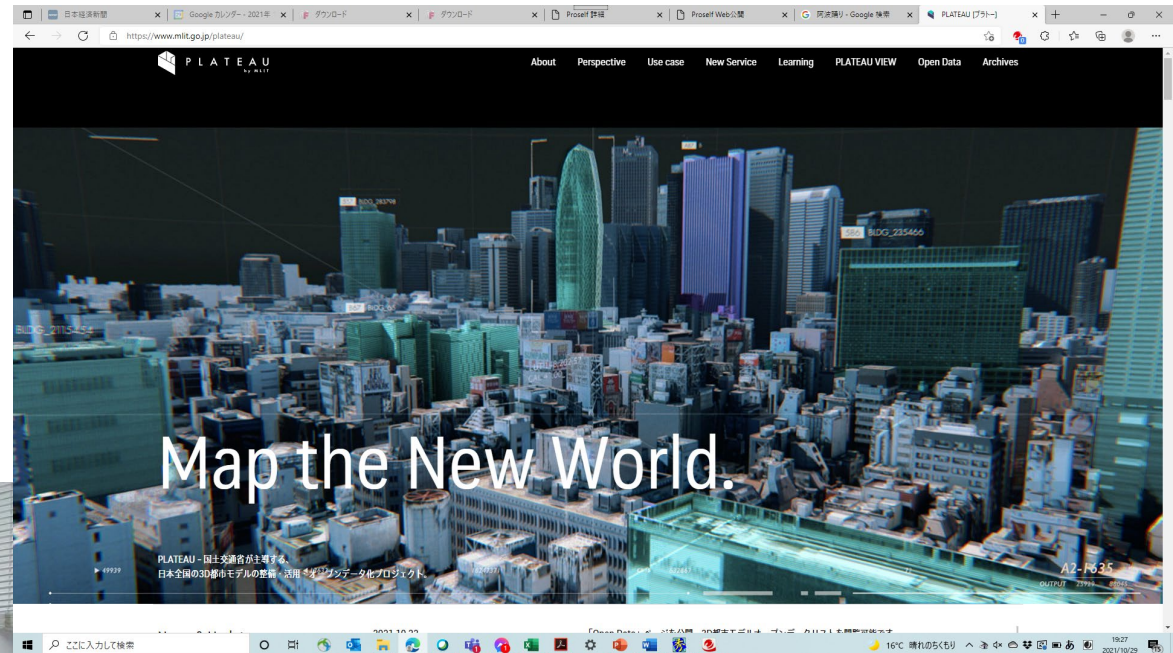
SIP4D promoted by CAO(at present)
Data share system for governments

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What is a digital twin? : Significance of digital

- Digital twin can be a kind of incubator for babies called AI.



Plateau by MLIT

Summary:

Try to consider from the viewpoint of Neo digital-native

- Toward Society 5.0

- Hunting-based society (1.0) → Agriculture-based society (2.0) → Industrial society (3.0) → Information society (4.0)
- In a sense, Society 3.0 and 4.0 might be based on the enslavement of humans.
 - Humans give instructions, but as a result, more humans are being used by machines or computers.
- In Society 5.0, AI will liberate humans from boring tasks. We will go towards a society where “**human sensibility and creativity**” are utilized.
- We may need to consider discontinuously rather than thinking from society 4.0 from the perspective of a world where people, things, money, and data are connected online.



Thank you for your kind attention.



Indigenous character in legend called "Namahage"
(OGA City Tourism Association)

Local efforts for disaster
prevention

common
sense

culture