GIS and Big Data as a Tool for Decision Making in Rescue Services

Pelastustoimen tutkimuspäivät, Emergency Services College, Kuopio, June 3rd 2019

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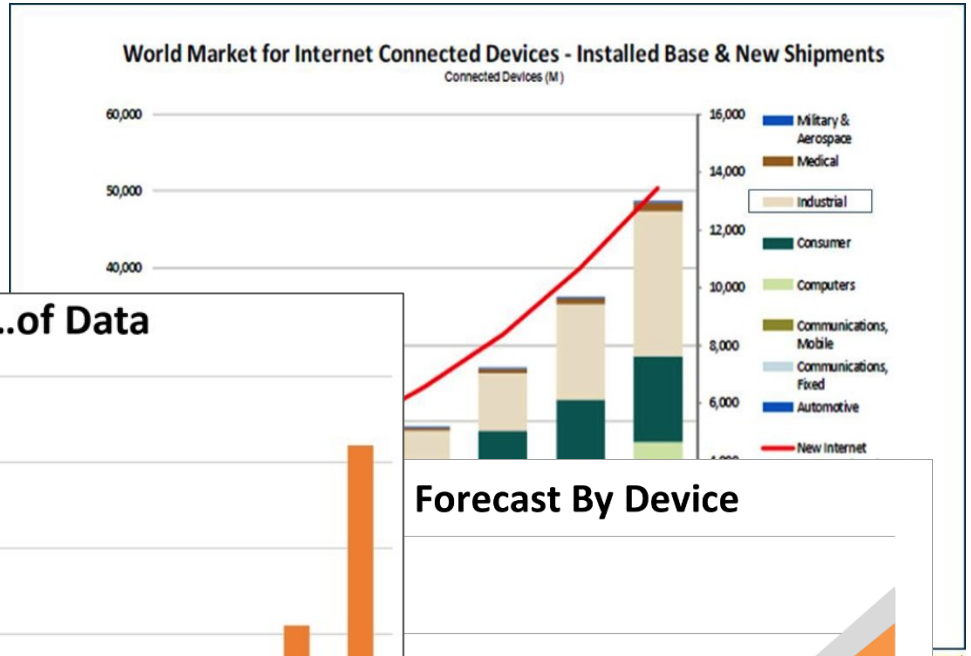
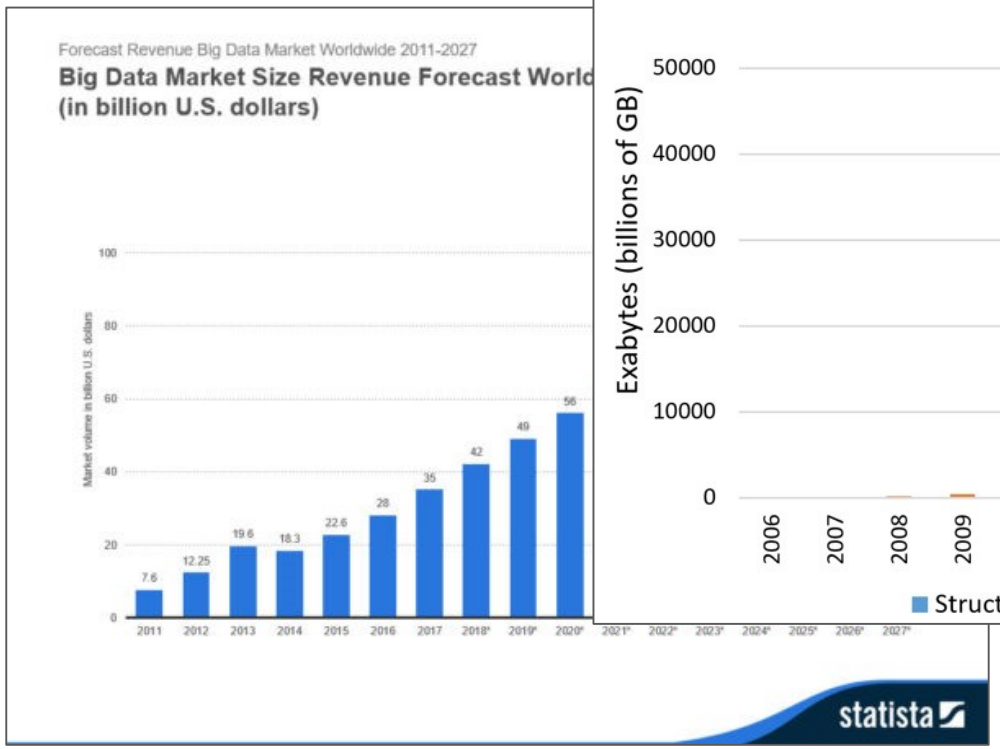
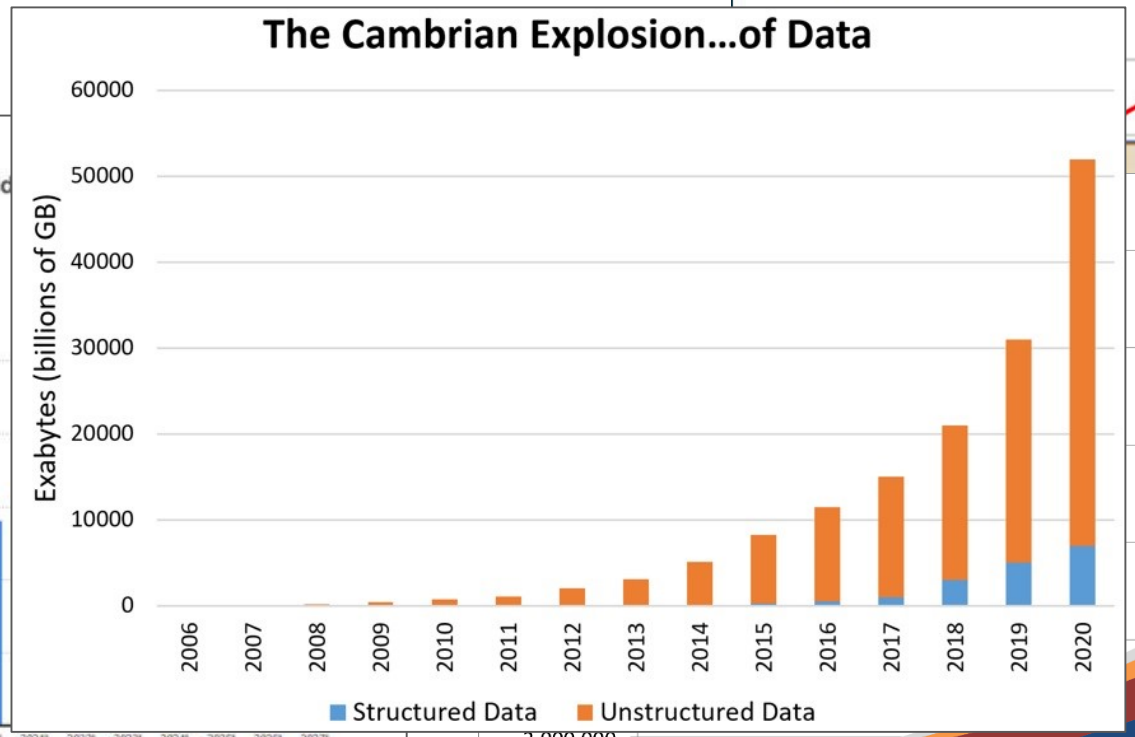
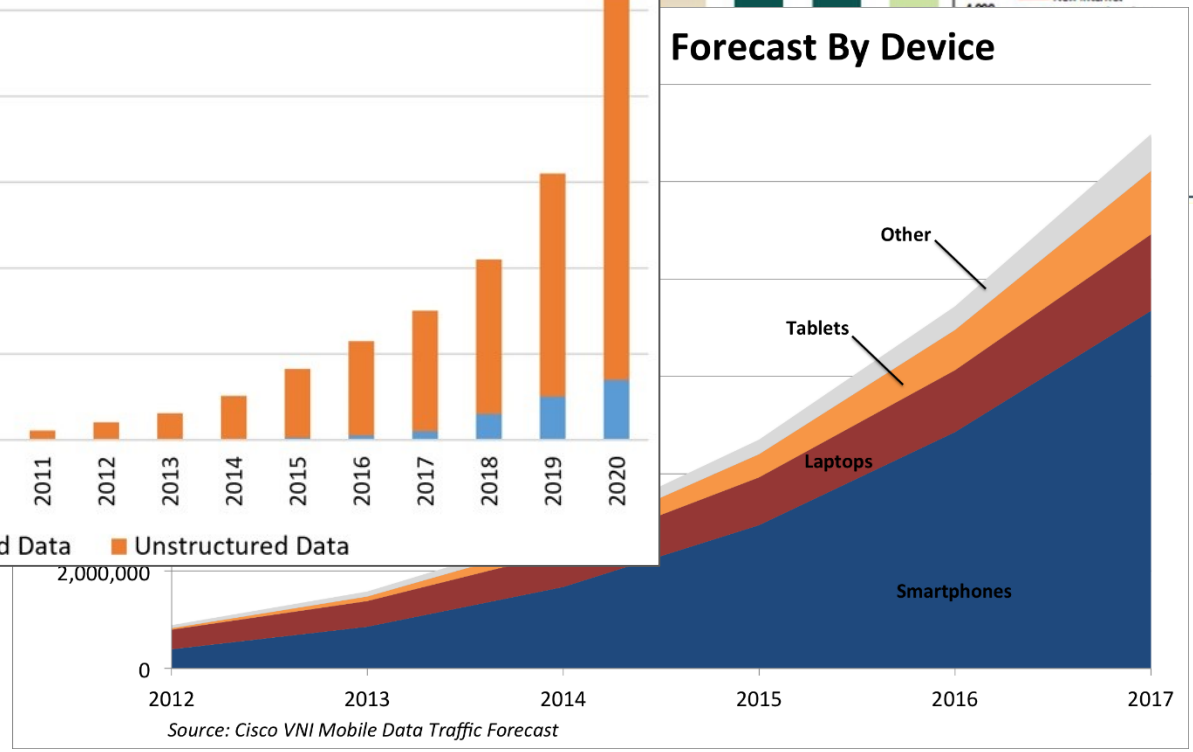
What is happening in the information society?









What is Big Data?

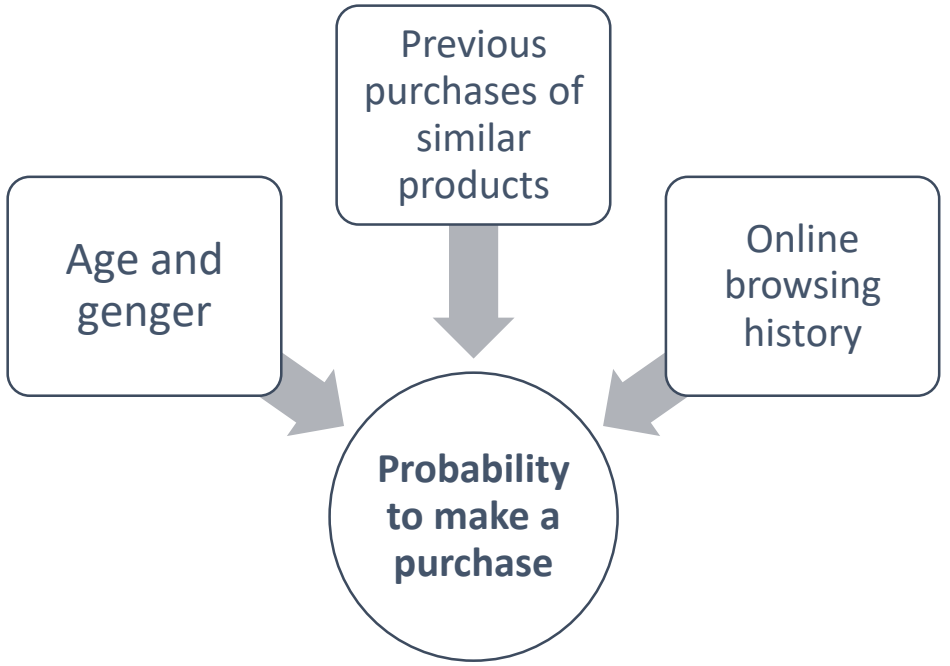
- Why is big data getting so important?

- Doug Laney, Gartner
  - "Big data" is **high-volume**, -**velocity** and -**variety** information assets that demand **cost-effective, innovative forms of information processing** for **enhanced insight and decision making**.

- Technical possibilities continuously advance
- Not anymore something that is rare or out of reach
- Becoming more and more valuable

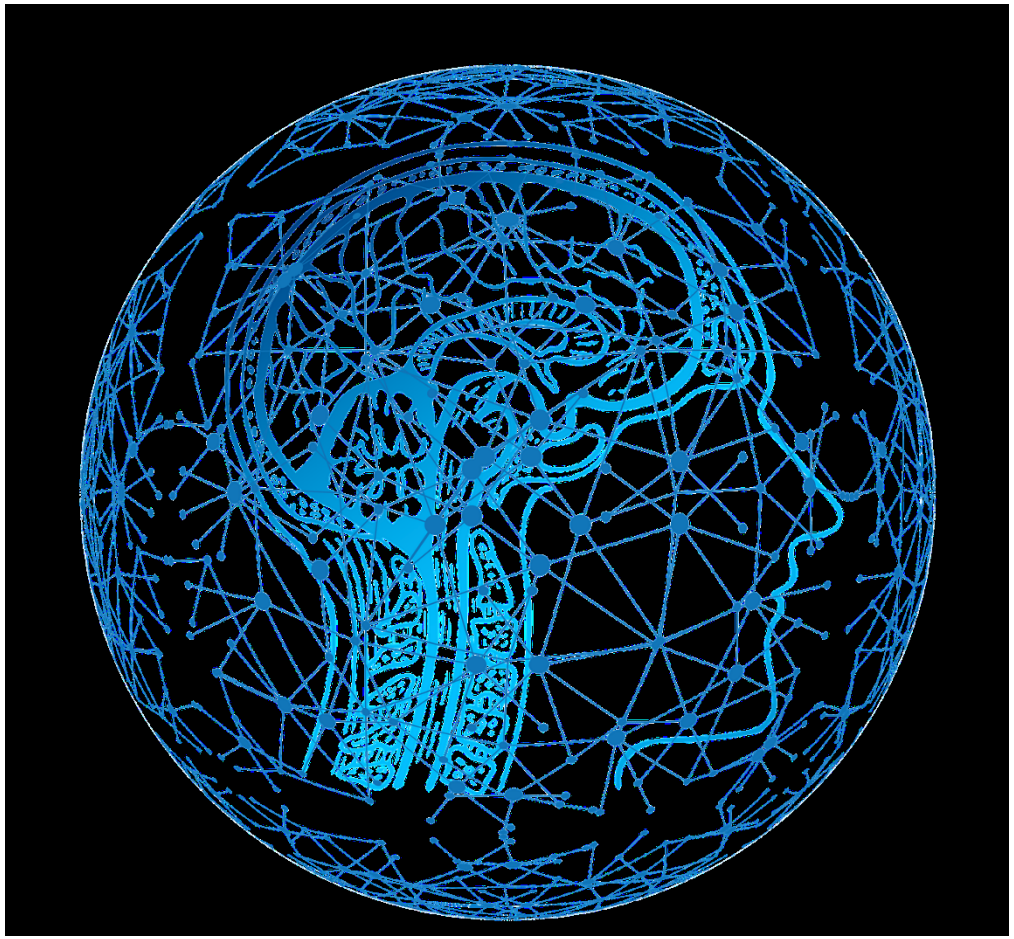
Predictive analytics

- *Predictive analytics is the use of data, statistical algorithms and machine learning techniques to identify the likelihood of future outcomes based on historical data (SAS)*
- Predictive modelling is traditionally based on different variations of regression analysis
  - Correlations between different qualities and specific outcome of interest



What is Artificial Intelligence?

- No officially agreed definition for AI
- Scientific discipline
  - Collection of concepts, problems and methods for solving them
- *Autonomy*
  - The ability to perform tasks in complex environments without constant guidance by a user.
- *Adaptivity*
  - The ability to improve performance by learning from experience.
- *AI and machine learning* can make predictive modelling more efficient

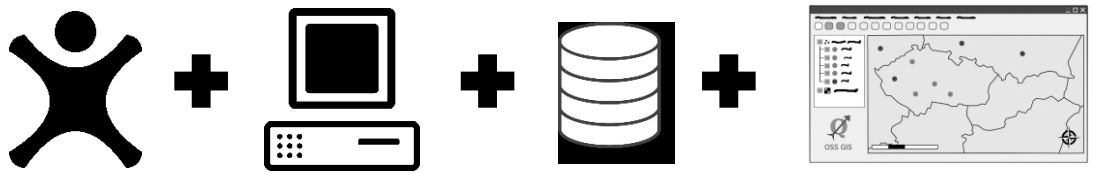


What is GIS?

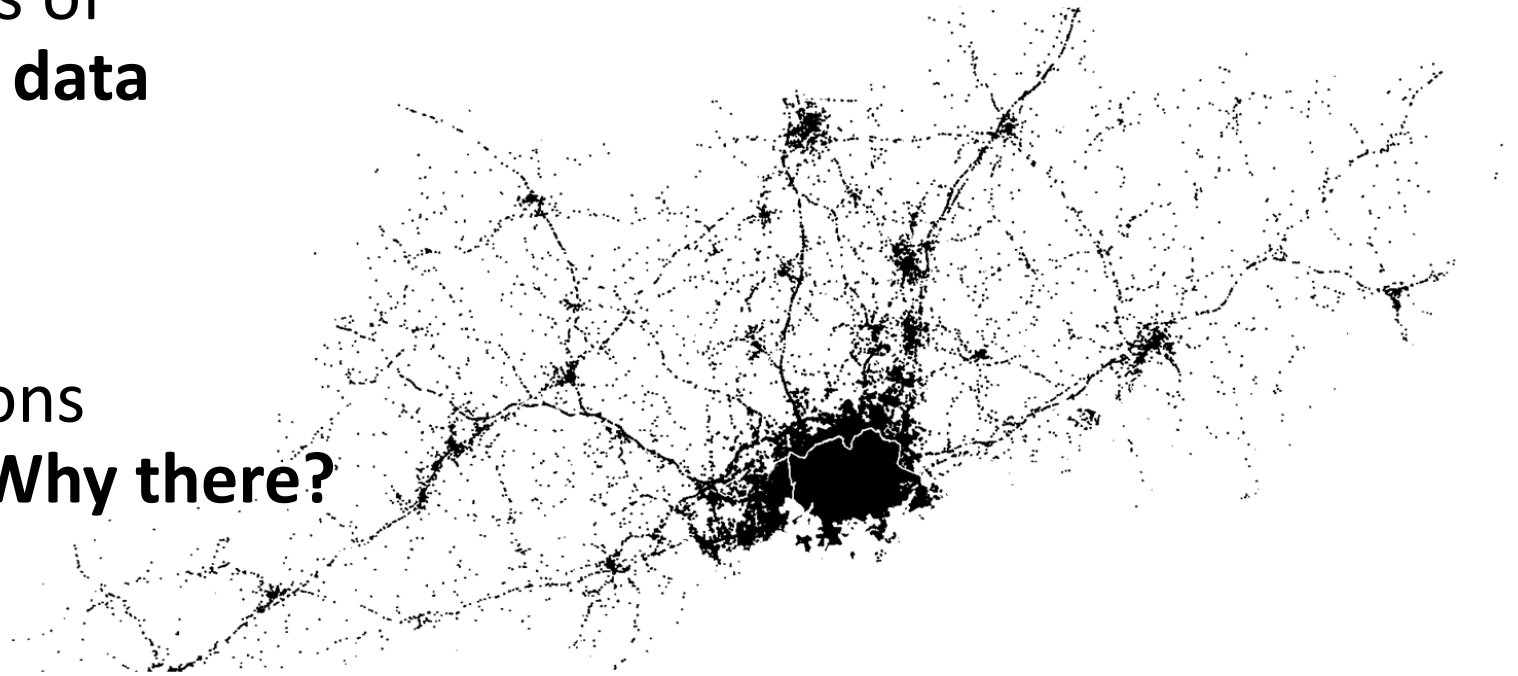
Geographic **I**nformation **S**cience

Geographic **I**nformation **S**ystem

- System for gathering, managing and analyzing spatial data
- Georeferenced data consists of **location data** and **attribute data**
- Stored as data layers



- Helps us answer the questions **What? How? Where? and Why there?**

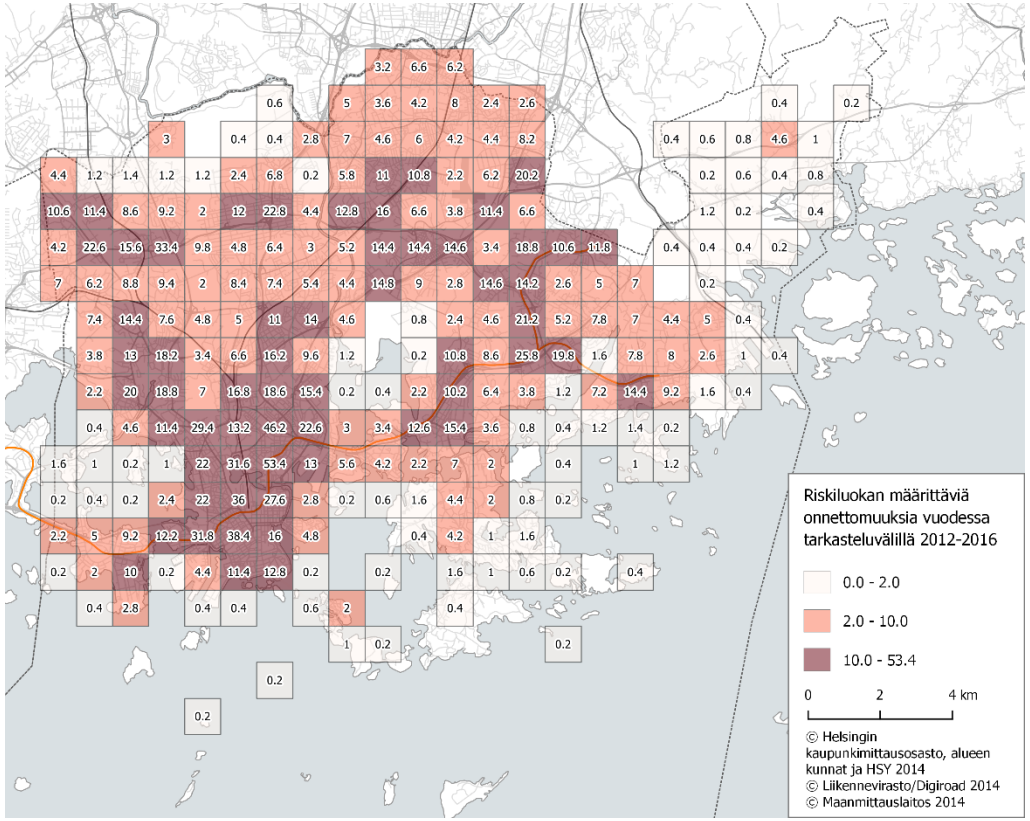


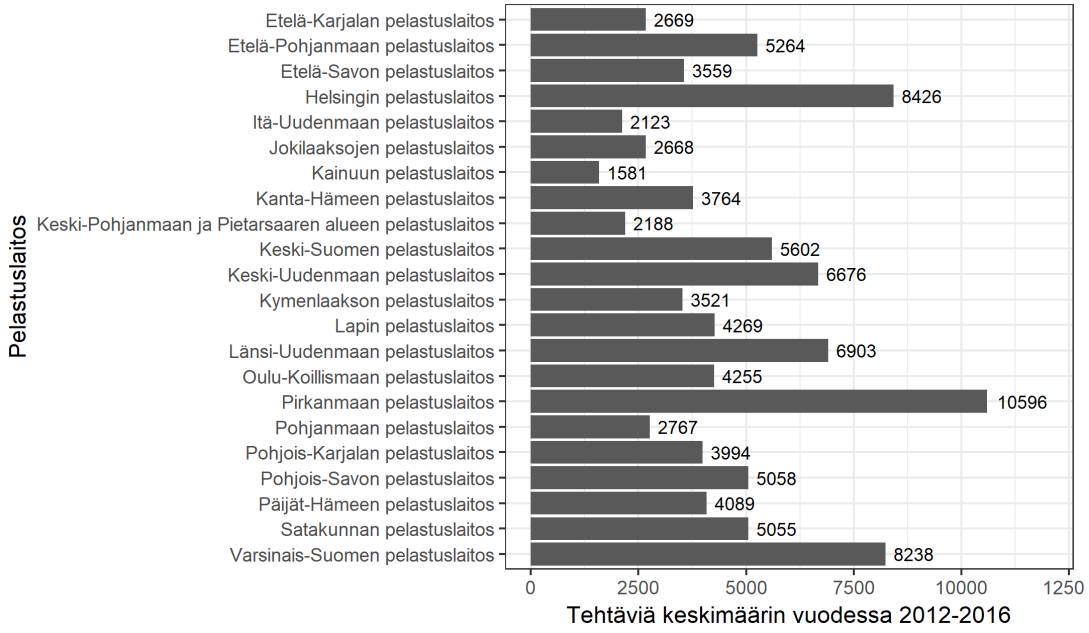
What are we interested in in rescue service's decision making?

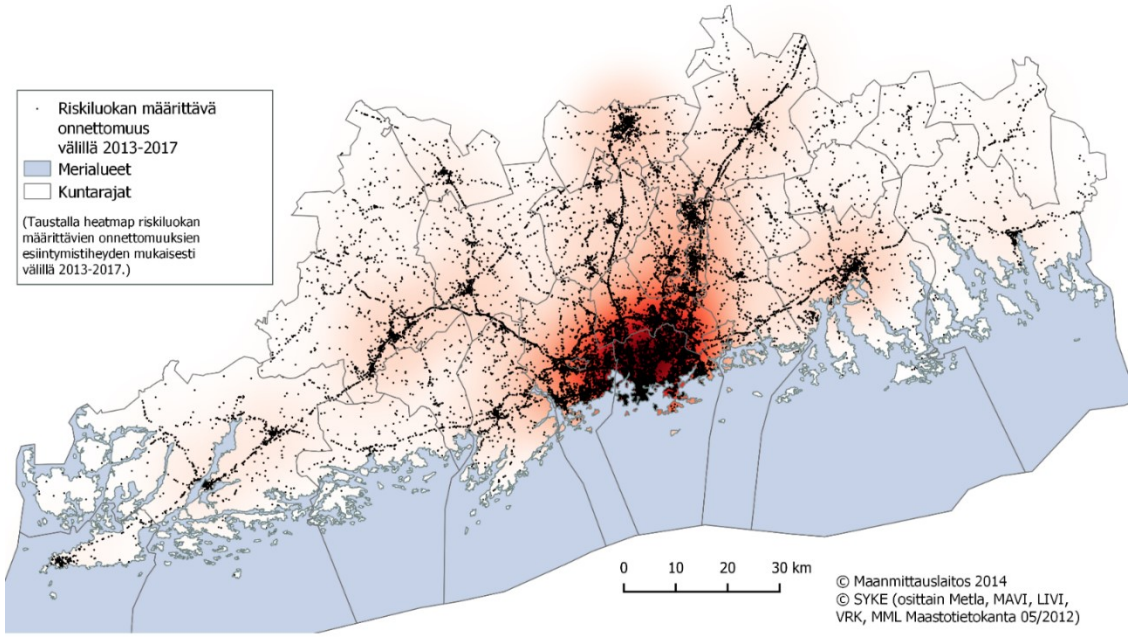
Rescue services are responsible for ensuring and improving safety and resilience in their area of operation.

(Gelinas, Sutton & Fedorowicz 2004)

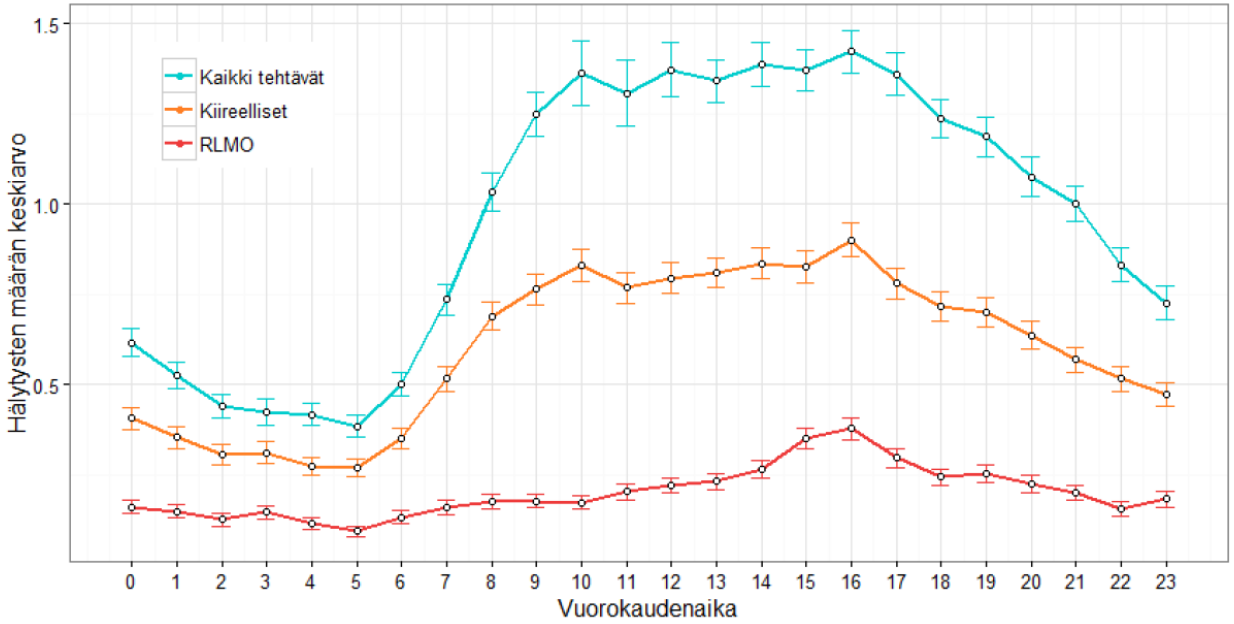
Where accidents happen?



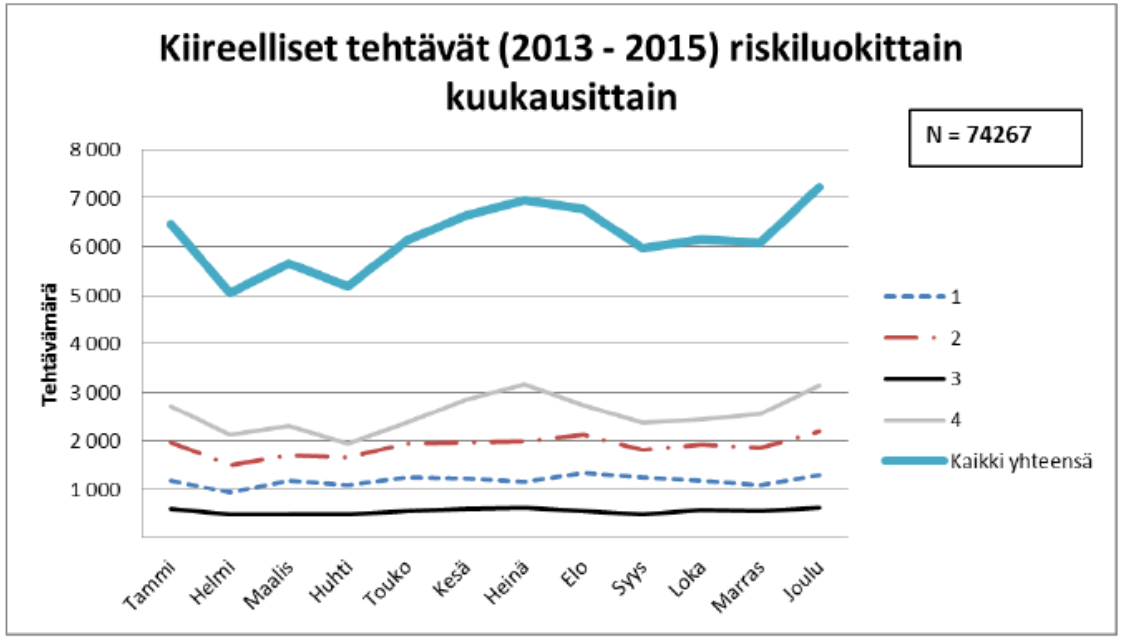




When accidents happen?



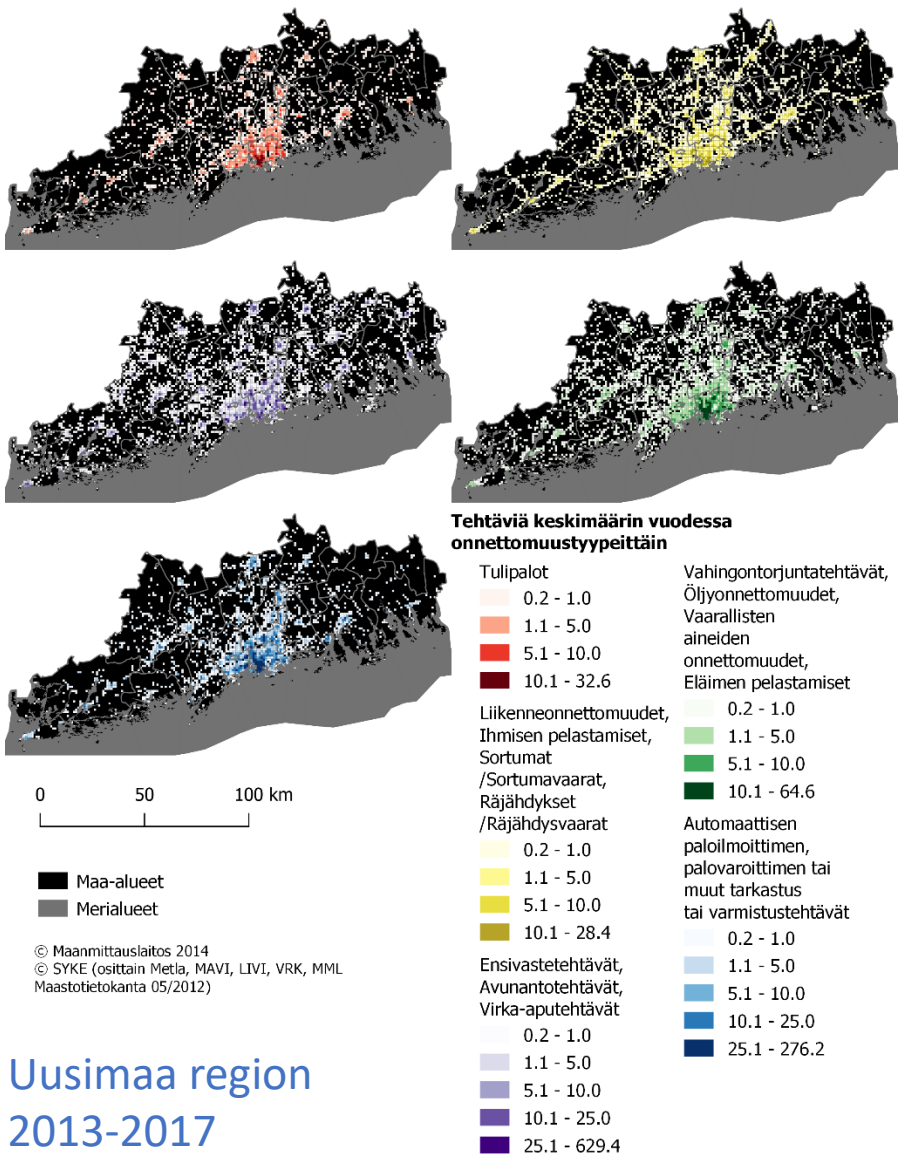
Helsinki 2011-2015



Finland 2013-2015

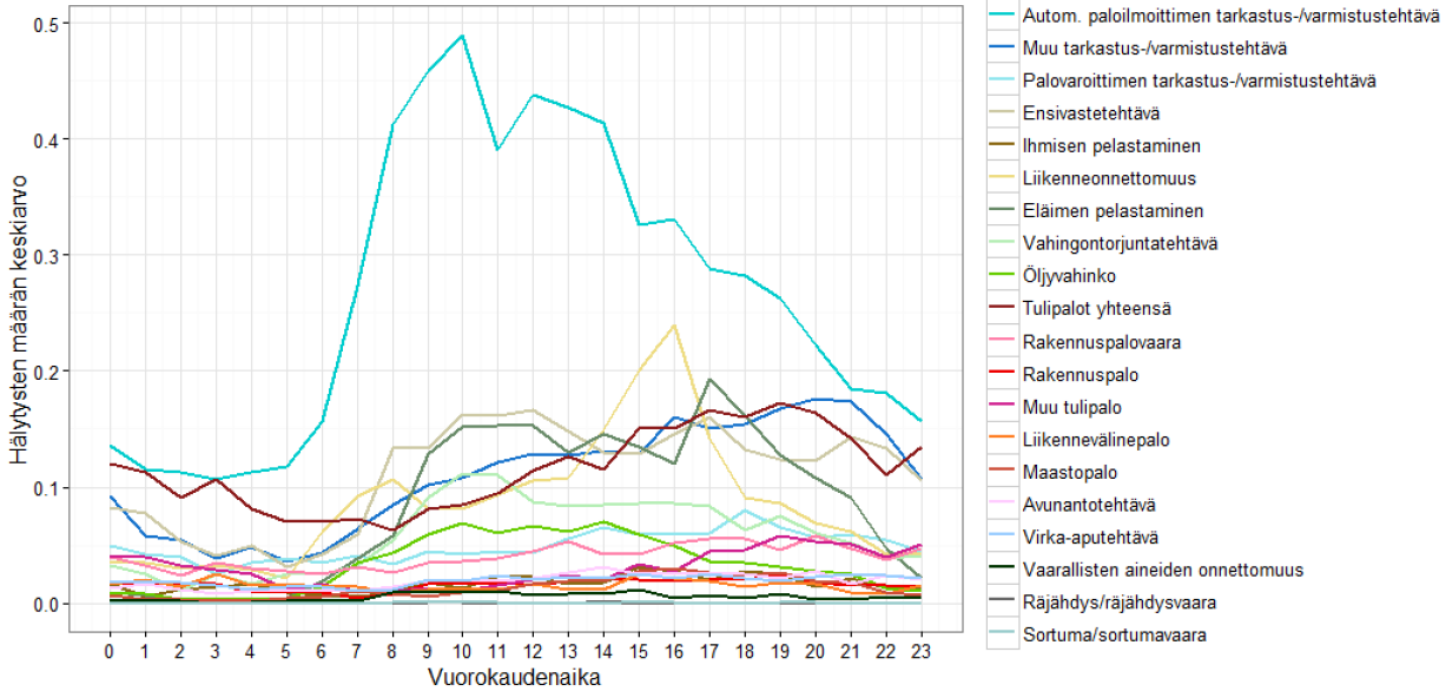
Pelastustoiminnan tilastokatsaus

Do different kind of accidents happen in different places or at different times?

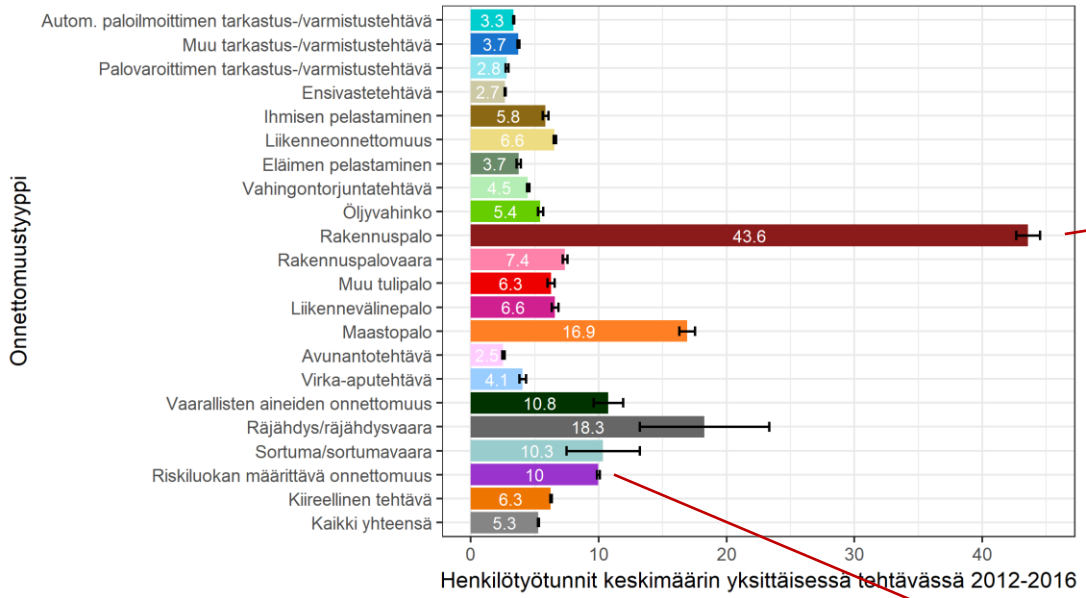


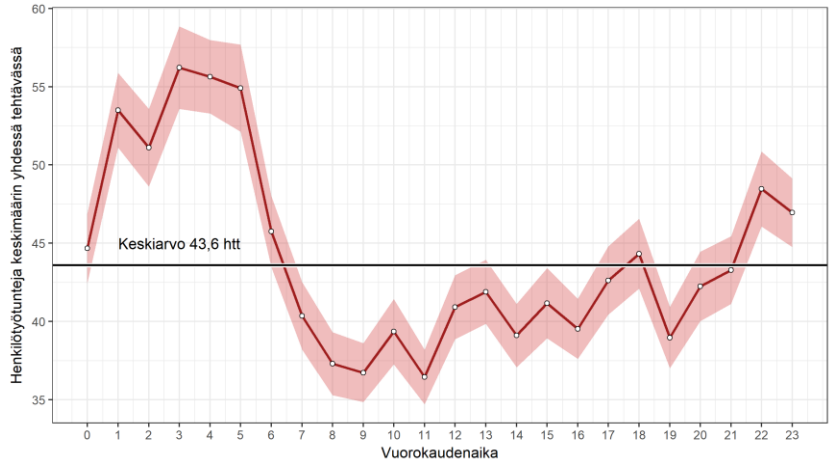
Uusimaa region 2013-2017

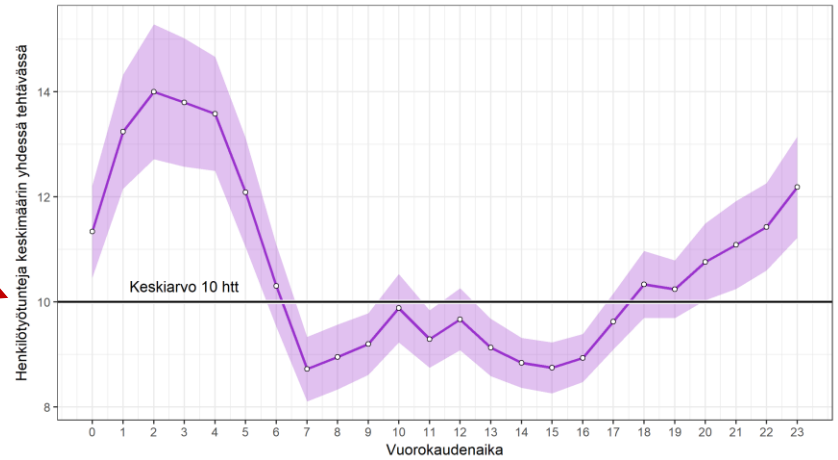
Helsinki 2011-2015



Do different kind of accidents require different amount of resources at different times?





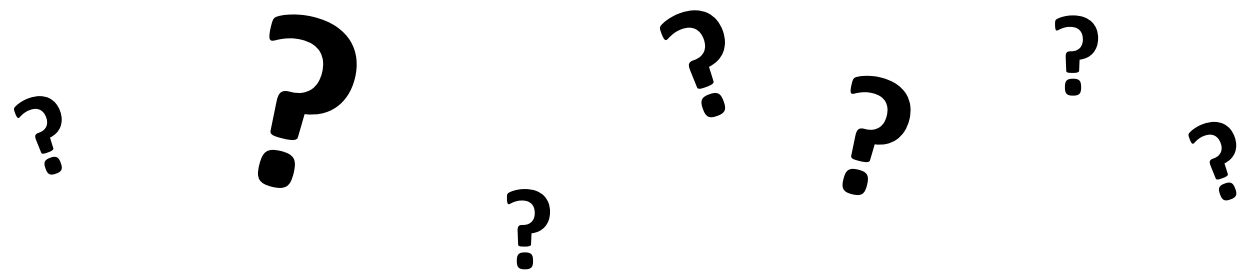


Finland 2012-2016

https://www.hel.fi/pela/fi/palaute/tutkimus-ja-julkaisut/julkaisusarja

What is missing?

- *Why there happens accidents where they happen?*
- *Why do they happen at the time they happen?*
- *Why they require more resources at specific time or cause damages and casualties more likely at specific time?*



Big Data: Providing Fire Service and Emergency Response Communities with Tools to Predict and Respond

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Source: http://www.firstnet.gov/newsroom/blog/nfpa-journal-big-data-transform-fire-service

New York City Fights Fire with Data

Analytics help New York City firefighters track potential hot spots.

BY BRIAN HEATON / MAY 18, 2015

FLICKR/CISC1970

News & Research / Publications and media / NFPA Journal® / 2014 / November December 2014 / November December 2014 / In Pursuit of Smart

IN PURSUIT OF SMART

As the amount of data produced increases exponentially, the fire service considers innovative ways to harness the power of information to help it save lives, reduce property loss, and protect firefighters—a brave new world of "smart firefighting"

By Jesse Ronan
Illustrations by Sean Rodwell

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Is Big Data Analytics The Secret To Successful Fire Fighting?

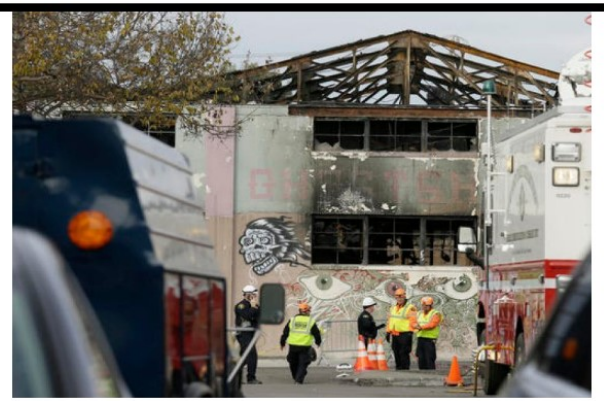
Bernard Marr Contributor

Fire Prediction: Making Sense of Big Data

Invest in data and the methods used to get the most benefits

03/10/2017

By Erich Roden



(AP Photo/Eric Risberg,File)

“Imagine you are an officer within a large metropolitan fire department. Having arrived at the firehouse a few minutes early before beginning your 15-hour tour, you head to your office, fire up your MacBook Pro, and begin scanning over your battalion’s emails for the day. Seeing the new Fire Forecast post just hit your inbox, you click on it and wait. Within seconds your computer screen lights up with what could be considered every fire official’s dream: a cache of data predicting the fire station’s calls-for-service during the next 24 hours. Over the next several minutes, you take note of its predictions, including six medical emergencies, two gas emergencies, one structural fire, and a motor vehicle accident with injuries. The analytics recommend ten in-service personnel to handle the projected call volume, three less than the current number already scheduled to work. As you click open the embedded map icon you evaluate the road conditions within your station’s area of responsibility — in real time. With heavy snow anticipated within the next several hours, the estimated response times throughout your district are constantly updating. Flashes of blue, red, and yellow light up your screen pulling your attention towards the geo-locating markers indicating where the predicted types of emergencies are likely to occur. Although the projections are never failsafe, they provide you with enough information to ready your crew. During your nightly hour-long skills session you select the most appropriate training drills to ensure each team member is proficient at handling these predicted types of emergencies.”

Firebird in Atlanta - Predicting Fire Risk and Prioritizing Fire Inspections

- https://youtu.be/l8en1xYMyBc
- An **Open Source Framework** developed by Data Science for Social Good, Atlanta
- *"Since implementation, it has been used to accurately predict fires 71% of the time in Atlanta and has a False Positive Rate of 20%"*
- *"shortcomings and lack of standardization in fire inspections and record keeping was a primary reason for Firebirds initiation"*

Reporting of preventative risk management

- We have a lot of information of accidents and rescue operations…
- Less information of preventative risk management activities
  - What was done? Where? When?
  - What kind of shortcomings in preparedness were recognized?
  - Where they and when were they fixed?
- ***”Valvontasovellus”*** -> developing a mobile application and inspection data base for fire inspections
  - Structural information of preventative activities -> quantitative data analysis
  - Connection to the accident data -> predictive modelling
  - Better surveillance of the safety in target buildings
  - Simplifying fire inspection process and reporting -> cost-effectiveness
  - Quality in customer service -> electronic services, homogeneity in service

Access to data

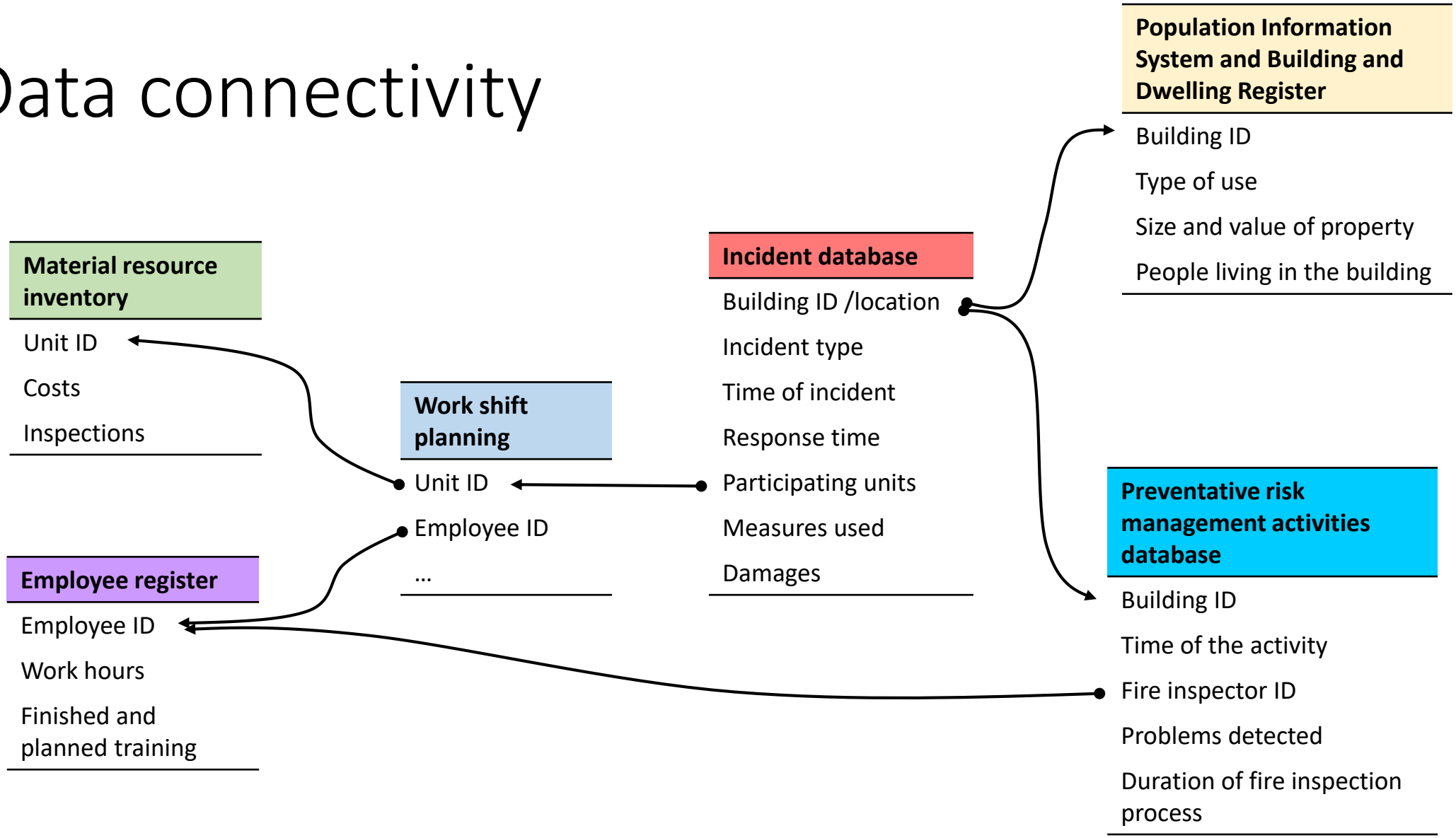
- *Data is valuable!*
- *Data is power!*

- We need strategic intent and common front to working towards getting access to data
  - Legal mandate, *Rescue Act 89 §* *(28.12.2018/1353)* ***”Tiedonsaantioikeus pelastustoimintaa ja valvontatehtäviä varten”***
- Co-operation with other officials
- Reciprocity -> We need to understand the value of our own data and market it

Open data and open source solutions!

- MapHub
- GitHub
- NY Open Data
- London Datastore
- Helsinki

Data connectivity



Accuracy and quality of data

- Is our accident data up to date?
- ***”Pronto”*** -> a good national accident database where all rescue departments in Finland report their operations
- Technologically and functionally the system is becoming out dated…
- We have recognized also some problems in data quality…

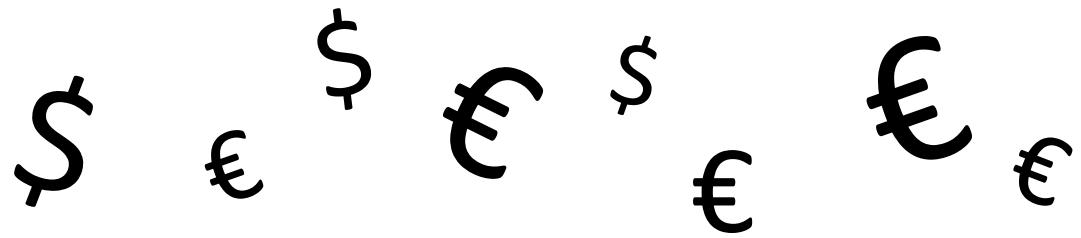
- The better data and data systems we have, the better research and analysis we can produce!

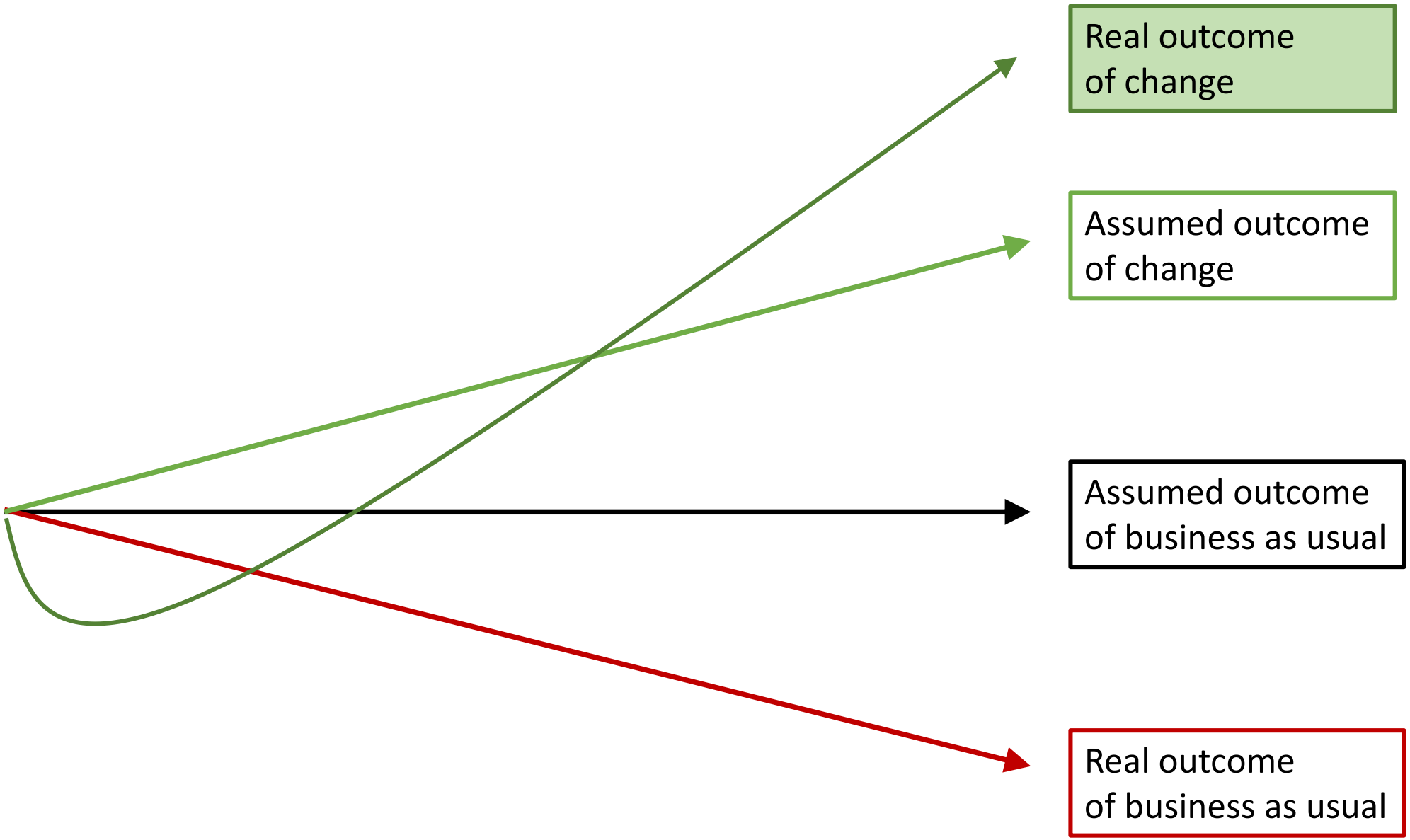
Data management and BI tools for rescue service

- Understanding of the value of data and information is growing…
- Need for nationally standard **indicators for service quality and BI tools**
  - Knowledge and information based management and decision making, service quality control etc.
- Need for **national data portal** which would
  - Combine data from various sources, our own databases and external sources
  - Flexible interface with default analytics and possibilities for own settings and applications
  - GIS data -> maps, visualisations, graphs etc.
- Still a long way to go! -> Key challenges have to do with **financing** and **finding strategic intent and common front**.
- We have embraced the idea that all rescue services in Finland would use the same databases and systems.
  - Better comparability and equality
  - Slow process with multi-level decision making

Resources

- Do we have a realistic picture of the costs and benefits of improving our data management?
- With the yearly cost of our accident database in Finland could we hire a couple of professional developers…?
- Dependence from service provider -> Importance of ownership
- Efficient use of open source solutions and sharing practices




Real outcome of change
Assumed outcome of change
Assumed outcome of business as usual
Real outcome of business as usual

Checklist

- ✓Database and structural data from preventative activities
- ✓Other databases up to date and attention to data quality
- ✓More access to external data sources, open and hidden
- ✓Make our own databases and open data ”talk to each other”
- ✓User friendly interface for examining and using the data and risk models

Thank you for your interest!

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