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Big Data & A.I. for modern Container Terminals

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Sweden - Great place to do
Software Engineering!

- Technologies:
  - **BIG DATA**
  - **A.I.**
- Opportunities
- Case study : UNCTAD
- Future Work

Big Data and Freight Transportation

Most discussed at TRB:

- Autonomous Vehicles
- Big Data and Freight Transportation

What is NOT Big Data

Everyone has an opinion about what Big Data is and is not. Let's be clear about what Big Data is NOT.

Just putting a "**Big Data**" stamp on it does not make it Big Data.

Big Data is not:

- **Lots of data**
- **Fast data**
- **Messy data**
- **Badly managed data**
- **Bigger databases**
- **Individual silos of data**
- **The result of regulatory data retention**

Analysis of bad data will result in bad information.

Data, Information, Knowledge

Data

- **Items that are the most elementary descriptions of things, events, activities, and transactions**
- **May be internal or external**

Information

- **Organized data that has meaning and value**

Knowledge

- **Processed data or information that conveys understanding or learning applicable to a problem or activity**

Big Data

Big data is a term for data sets that are so large or complex that traditional data processing applications are inadequate.

Challenges include analysis, capture, data curation, search, sharing, storage, transfer, visualization, querying and information privacy.

Often refers simply to the use of predictive analytics or certain other advanced methods to extract value from data, and seldom to a particular size of data set.

Accuracy in big data may lead to more confident decision making, and better decisions can result in greater operational efficiency, cost reduction and reduced risk

Big Data

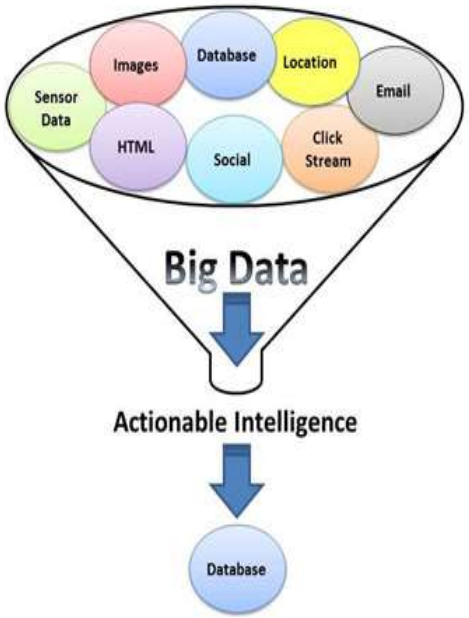
Data sets are growing rapidly in part because they are increasingly gathered by cheap and numerous information-sensing mobile devices, aerial (remote sensing), software logs, cameras, microphones, radio-frequency identification (RFID) readers and wireless sensor networks.

Every day 2.5 exabytes (2.5×10^{18}) of data are created.

Drone to be used for traffic analysis in part of Swedish road network

What is Big Data

BIG DATA: "The collection, processing and usage of large volumes of digitized data to improve how companies make important decisions and operate the business."

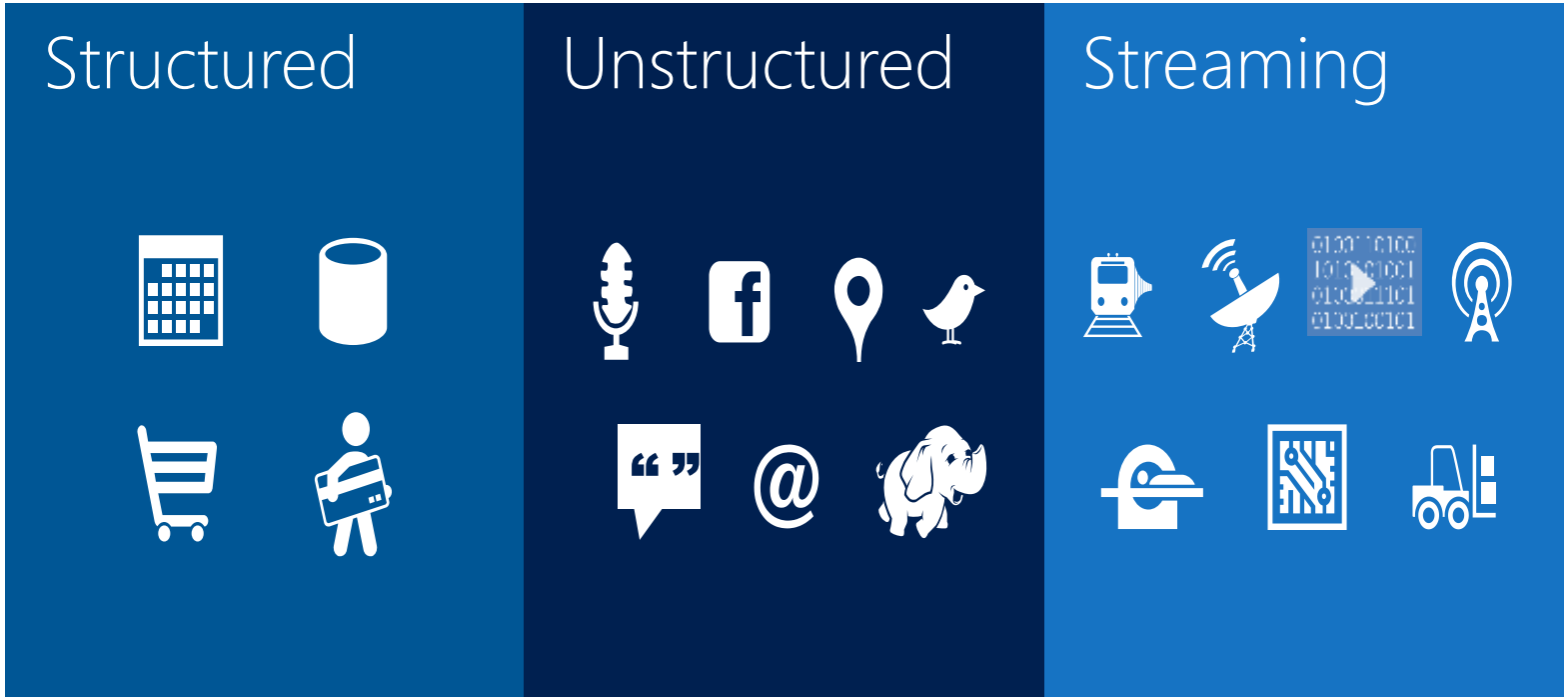


What is Big Data:

- **Unstructured data / Machine data**
- **Aggregated click streams**
- **Previously unconnected data feeds**
- **Horizontal analysis across vertical silos**
- **Insights from analysis of multiple data pools**
- **Sentiment analysis within communities (staff / consumers**
- **Predictive Analytics replaces Routine Maintenance**

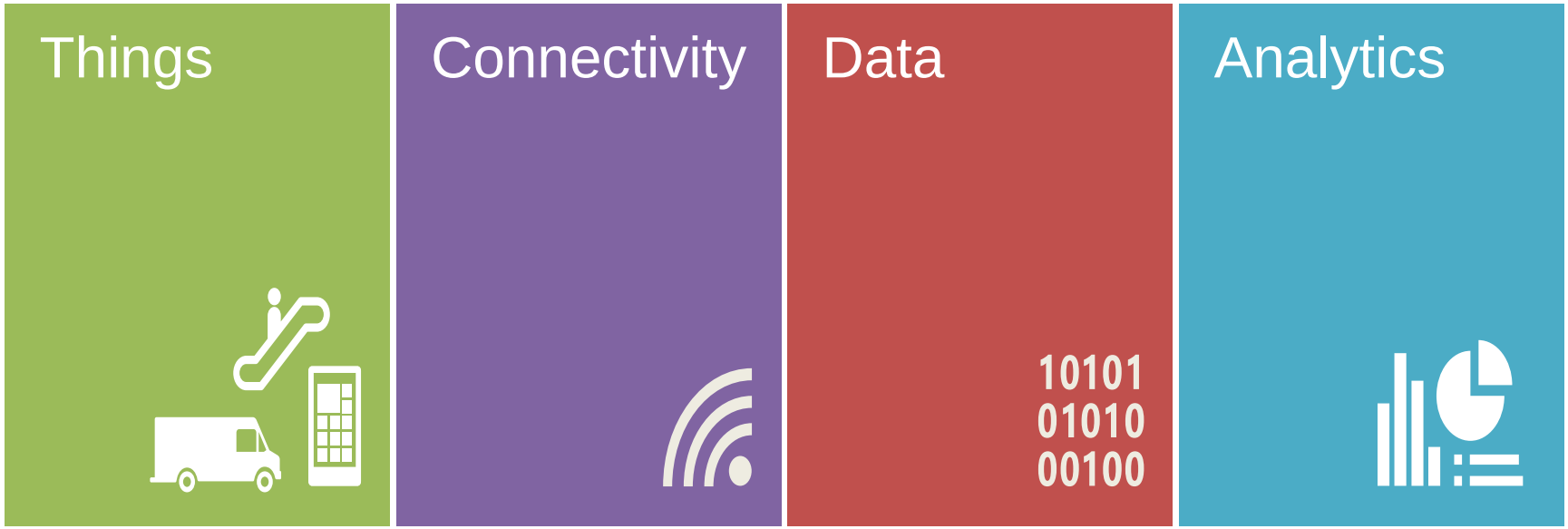
What is Big Data

Harness the growing and changing nature of data



- Challenge is combining transactional data stored in relational databases with less structured data
- Big Data = All Data
- Get the right information to the right people at the right time in the right format

What is the Internet of Things?



IoT = sensor-acquired data

Why Big Data?

Data is becoming a resource in its own right, and offers incredible possibilities for understanding every aspect of your business better..

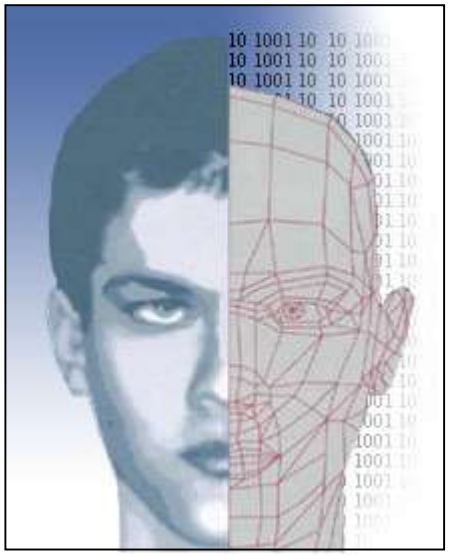
Computer analysis of Big Data goes far beyond human capacity in providing information that can make a maritime operation more efficient. For example, with real-time analysis of such data as engine monitoring, consumption rates for various fuel types, the fixed running costs, and weather data, a maritime operation can optimize for financial performance rather than just time or distance.

Utilising Big Data is widely known; a study by the Massachusetts Institute of Technology (MIT) found that data-driven firms perform 5%-6% better each year.

Artificial Intelligence : A.I.

Many successful applications

Data Mining
Decision Support Systems
Multi-agent Systems****
Information Filtering
Pattern- / Face Recognition
Games*



- Technologies:
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- **Opportunities**
- Case study : UNCTAD
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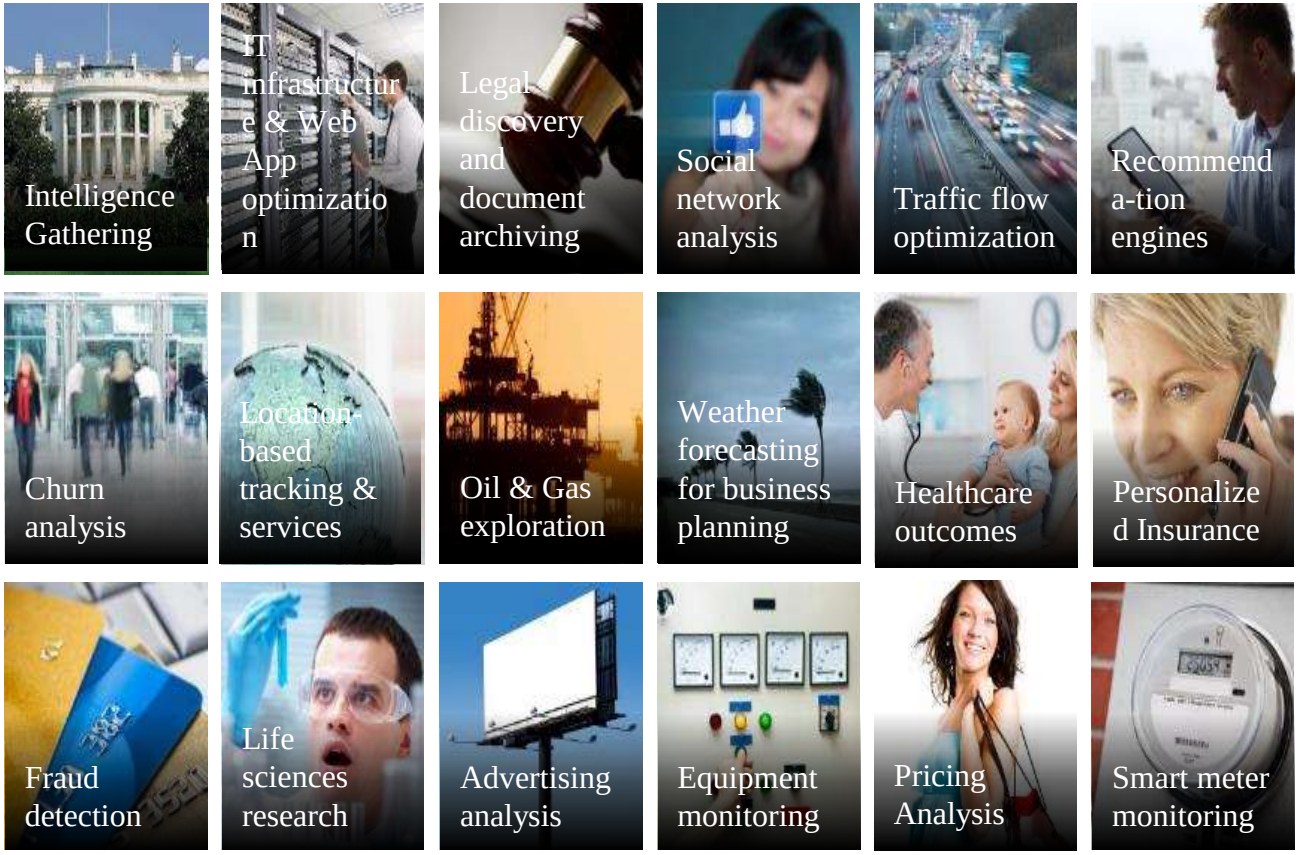
Data Analytics is needed everywhere




PORTS !!!

Ship to Shore Interface

Load profile

Work scheduling fc

Berth Planning System

Optimum port Capacity while incurring minimum cost.

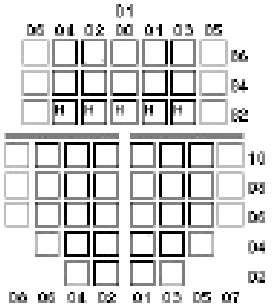
Where shall vessel dock at the berth?

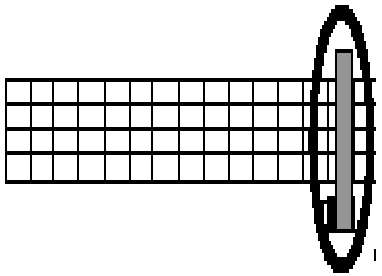
Transfer System

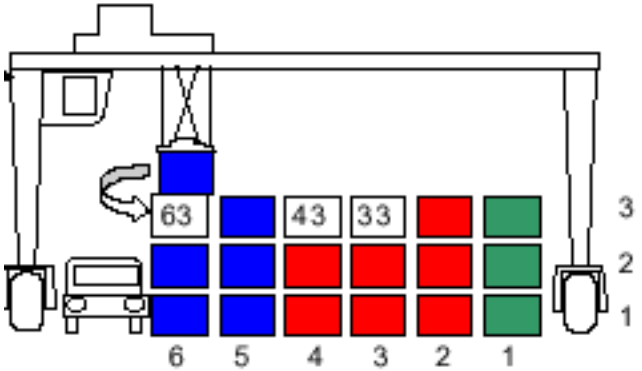
Load sequence

Routing problem

Pickup sequencing







Container Storage System

Stacking density

Yard configuration

Automatic container allocation

Delivery and Receipt System

Control access to the terminal of the trucks

EDI for container accuracy

Artificial vision

Example of Big Data application

Leidos (SAIC), analyzed Port of Oakland data including engine age and trip schedules and determined that **32%** of the drayage fleet would not meet the California Air Resource Board rules. As a result, container movement **would decrease 38%** and a drayage driver shortage would lessen competition and raise rates. The extra costs could potentially deter shippers' use of the port.

Analyzing the data allowed visualization of the impact of government regulation on the port and the economy. Responding in advance can improve the outcome. For example, when CARB rules disallowed pre-2007 model trucks, the **port offered incentives for the carriers to purchase new trucks or retrofit their existing vehicles**.

Big Data provides better insight into problems, interactions and organization and allows members of the logistics industry to respond more efficiently.

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UNCTAD
Trade Logistics Branch, Division on Technology and Logistics
Transport Newsletter

Country connectivity by container line shipping: A tool for analysing, simulating and visualising connectivity

A challenge in understanding container ship connectivity is the difficulty of analysing or visualising the large amount of data or information available. The application of information and communication technologies can help with analysis, simulation and visualisation. Recently Lawrence Henesey and a group of students (Phillip Alipour, Mahwish Anwar and Davood Zall) from the Blekinge Institute of Technology in Karlshamn, Sweden, volunteered to develop an intelligent decision support system that incorporates a number of web-services and databases, including UNCTAD's LSCI and related data, to calculate trade paths. This comprehensive tool provides trade analysis and visualisation that can be viewed with Google EarthTM.

For planning and optimisation, the software can be used to visualise the best path between two or more nations based on real-time environmental, economic and technical factors. It can also calculate various sea paths, allowing users to integrate the impact of financial crises, environmental hazards, investment and trade. The tool can evaluate historical data with real-time data to identify alternative connectivity paths when traditional paths are affected by such factors as earthquakes, flooding, hurricanes, theft, piracy, radiation and strong winds. Therefore, with regard to the analysis of liner shipping connectivity between nations, a substantial amount of collected data can be processed in combination with real-time data.

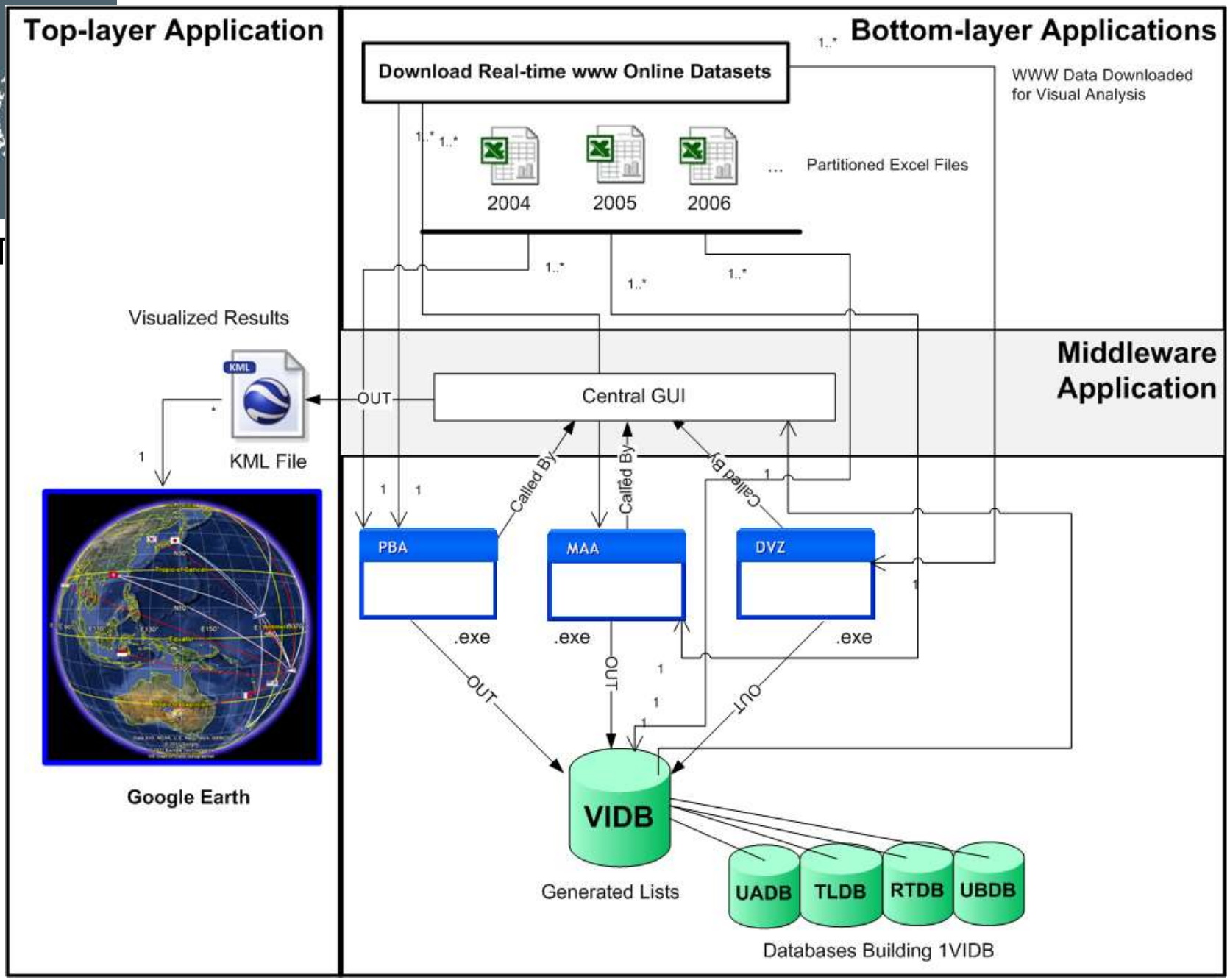
An introduction to this tool can be found at http://www.youtube.com/watch?v=dZ4Fl_KXm0Q. For more information, contact Lawrence Henesey, lhe@bth.se, Assistant Professor, School of Computer Science, Blekinge Institute of Technology, Karlshamn, Sweden

Introduction

- An intelligent decision support system (**IDSS**) for container shipping based on data partially submitted by UNCTAD (United Nations Conference on Trade And Development)
- We have incorporated novel features, which are documented, for conducting the following:
  - Analyzing + Visualizing real-time data on Environmental Factors, such as Hurricanes, Earthquakes, Radiation affecting paths, etc.
  - Analyzing + Visualizing real-time data on Economic Factors, such as evaluating the transportation route's gravity of trade, economic stability, its viability for being used by source nodes for a destination node.

Short Description

- A Visualization, Simulation and Analysis tool on Historical/Real-time Data for:
  - Visual path weights,
  - Sorted ranks relative to 6 transportation parameters,
  - Visual routes,
- Visual Alternative paths relative to global parameters such as:
  - Real-time Economic,
  - Real-time Environmental factors as surveyed between ports in form of a displayable matrix in Google Earth (GE).
  - In this project, we mainly introduced country-pairs based on our initial dataset.

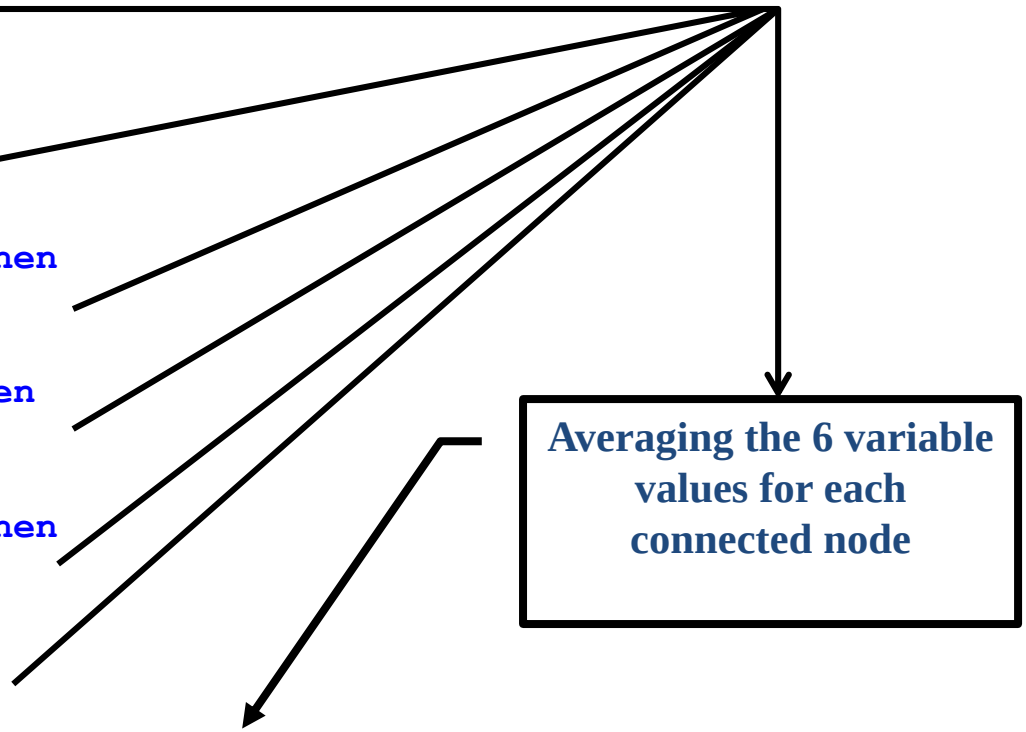

Top-layer Application
Bottom-layer Applications
Download Real-time www Online Datasets
WWW Data Downloaded for Visual Analysis
1..*
2004
2005
2006
...
Partitioned Excel Files
Visualized Results
KML
KML File
OUT
Central GUI
Middleware Application
Called By
PBA
MAA
DVZ
.exe
OUT
VIDB
Generated Lists
UADB
TLDB
RTDB
UBDB
Databases Building 1VIDB
Google Earth

Design and Components

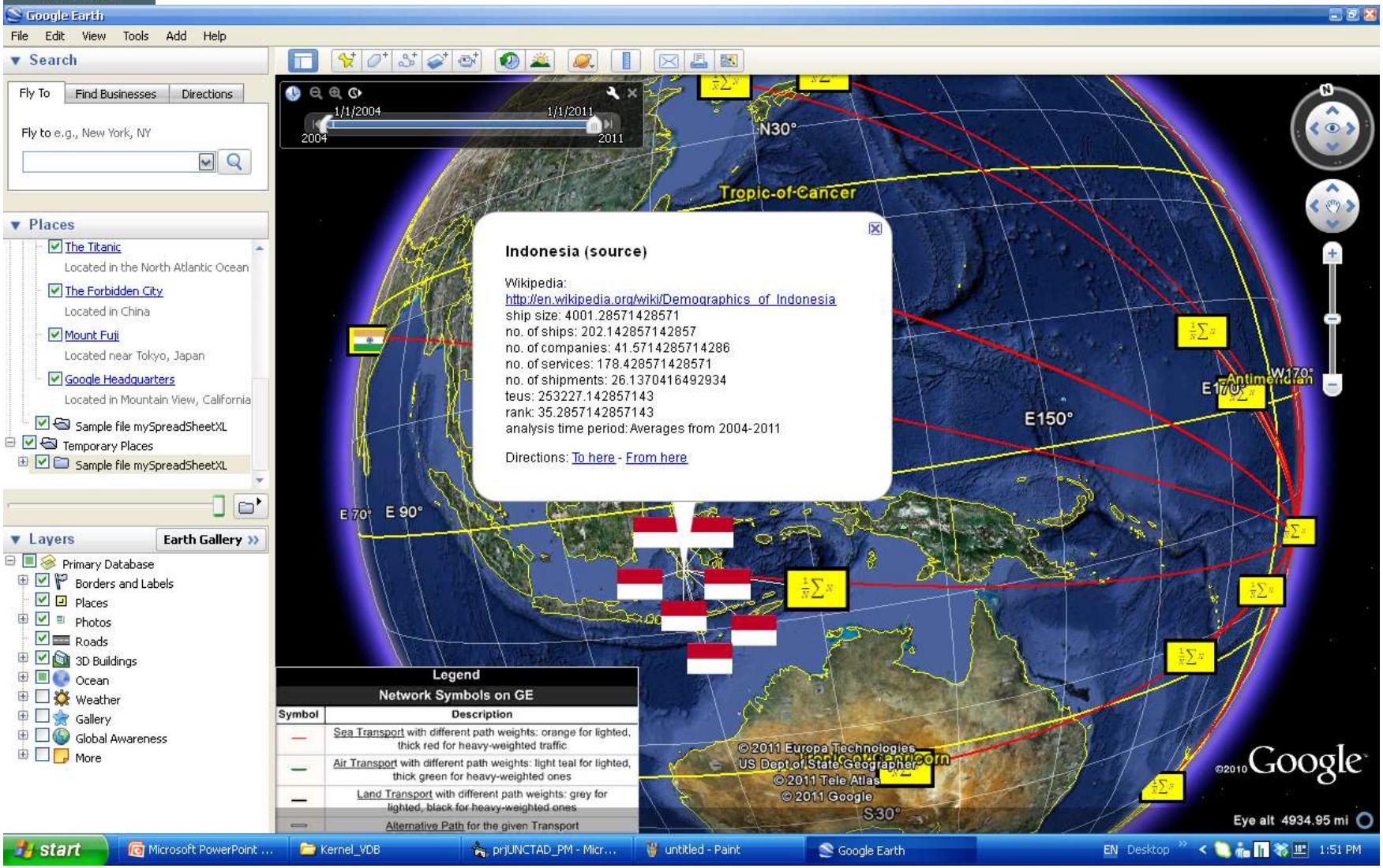
- **Current Application Capacity**: 14 entries that are paired thus yielding a maximum of 28 countries.
- The main user interface (GUI) supports the user on **historical data**, **real-time data** and **customized data**.
- **Automation:** Our main engine runs executables after analyzing real-time data worldwide relative to historical data on our hard drive when user clicks on the relevant option/button.
- The final output is a visual result as a KML or KMZ file in GE.
- Let's run the prototype.

Methods and Analysis

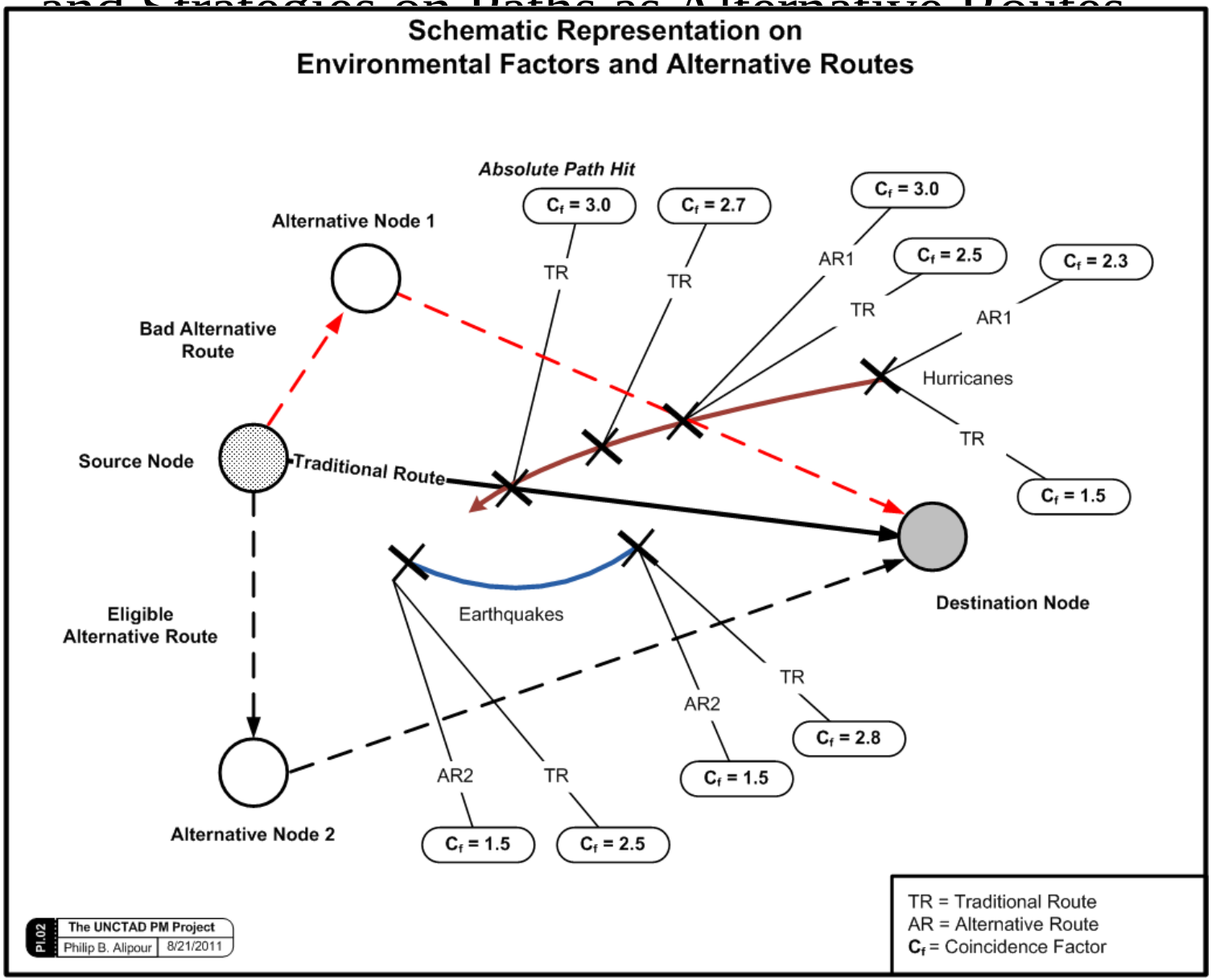
```
For All C1 AND C2's {
If Ship Size = Min Then
Line Width is a = 1.0
End If
If # of Ships = Max Then
Line Width is b = 3.0
End If
If # of Companies = Max Then
Line Width is c = 3.0
End If
If # of Services = Max Then
Line Width is d = 3.0
End If
If # of Shipments = Max Then
Line Width is e = 3.0
End If
If TEUs = Mid Then
Line Width is f = 2.0
End If
Line Width out = (a + b + c + d + e + f)/6
}
```



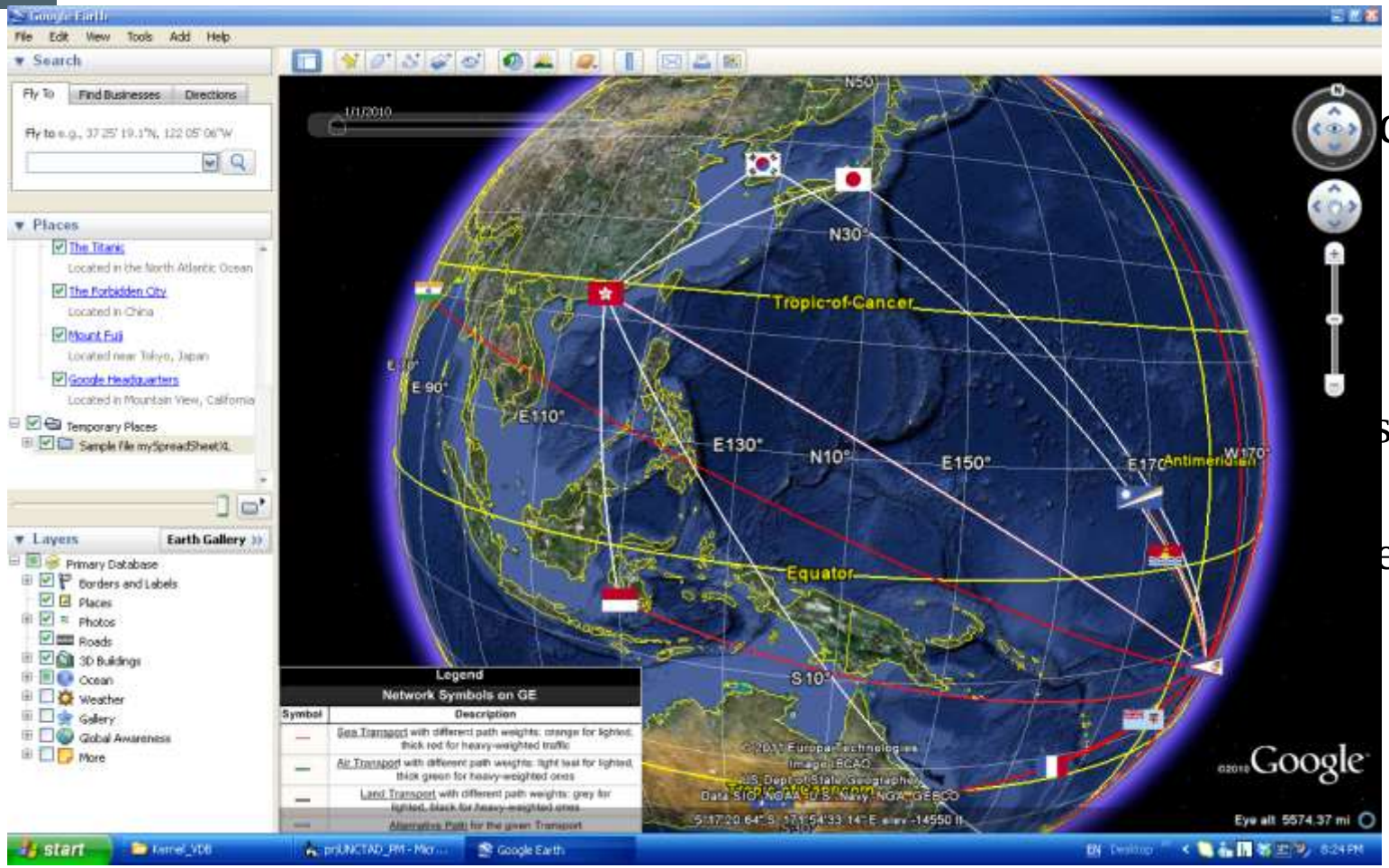
Prototype on Historical Data



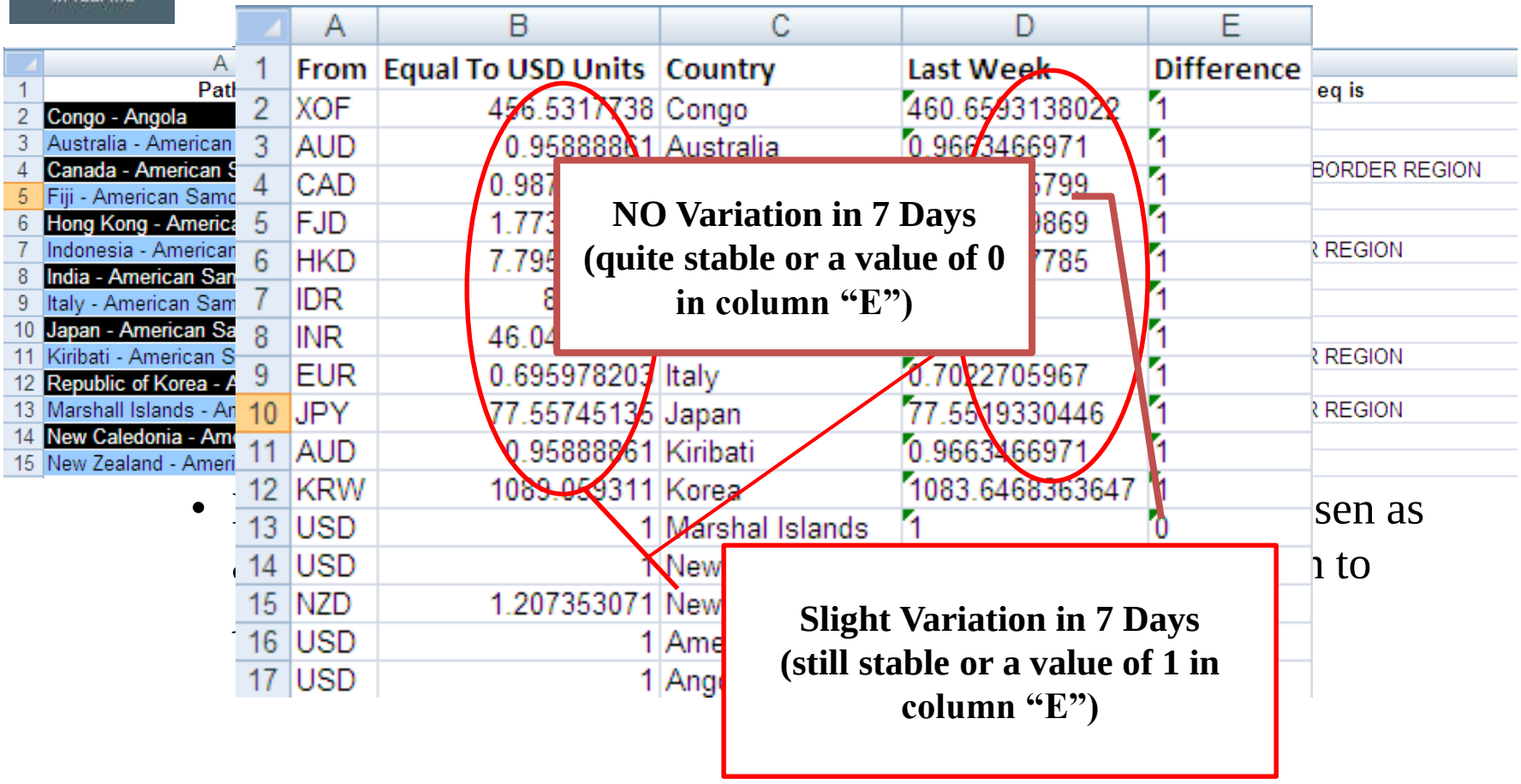
Combinatorial Optimization, Polygonal Analysis and Strategies on Paths as Alternative Routes

- 

Calculating Alternative Routes



Database and Mean Values Normalization for Accurate Analysis



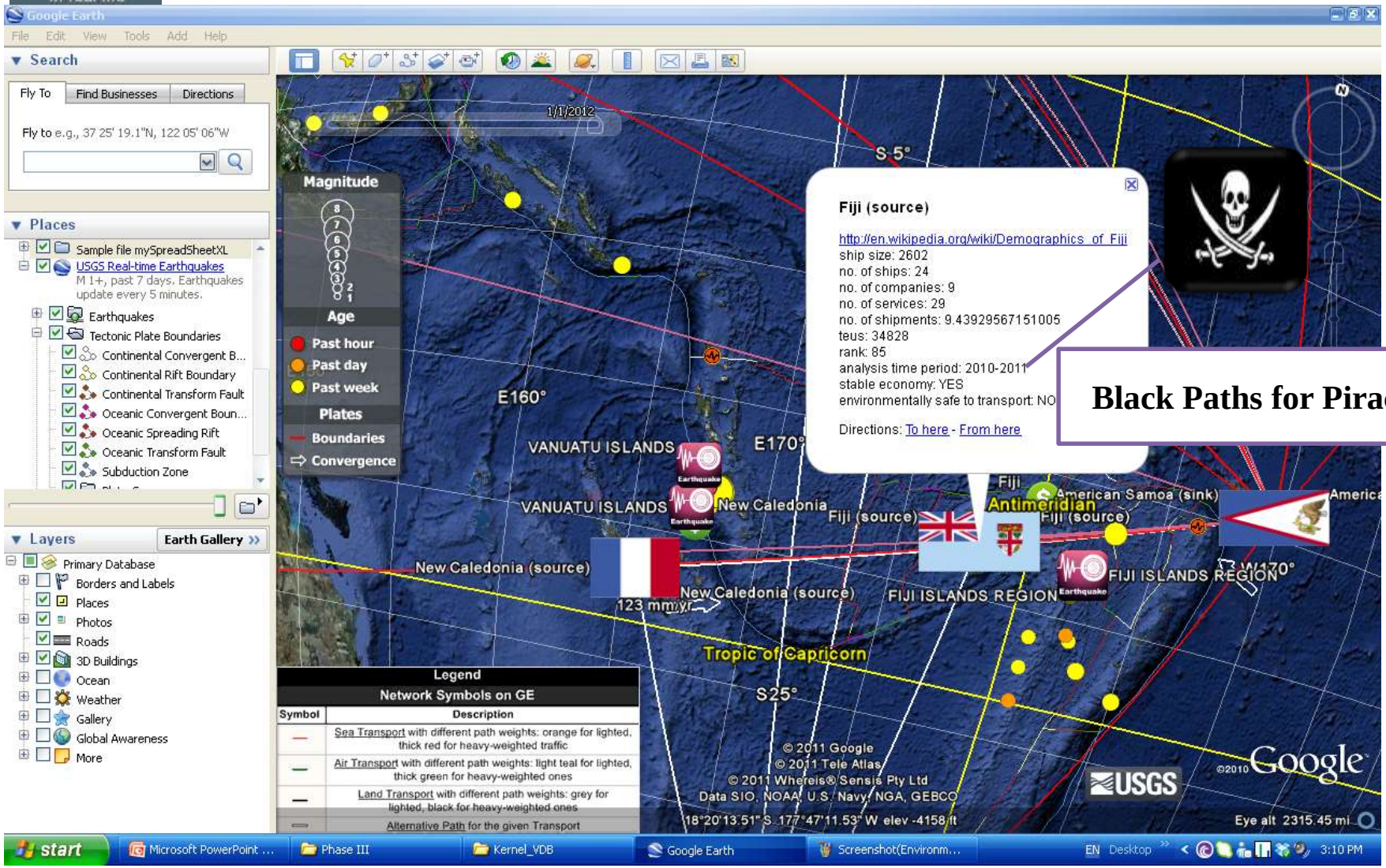
	A	B	C	D	E
1	From	Equal To USD Units	Country	Last Week	Difference
2	XOF	456.5317738	Congo	460.6593138022	1
3	AUD	0.95888861	Australia	0.9663466971	1
4	CAD	0.987		5799	1
5	FJD	1.773		9869	1
6	HKD	7.795		7785	1
7	IDR	8			1
8	INR	46.04			1
9	EUR	0.695978203	Italy	0.7022705967	1
10	JPY	77.55745135	Japan	77.5519330446	1
11	AUD	0.95888861	Kiribati	0.9663466971	1
12	KRW	1089.059311	Korea	1083.6468363647	1
13	USD	1	Marshal Islands	1	0
14	USD	1	New		
15	NZD	1.207353071	New		
16	USD	1	Ame		
17	USD	1	Ang		

NO Variation in 7 Days (quite stable or a value of 0 in column "E")

Slight Variation in 7 Days (still stable or a value of 1 in column "E")

- sen as
- n to

Color Coding the Alternative Paths for Accurate Analysis



YouTube Video :

https://www.youtube.com/watch?v=dZ4Fl_KXm0Q

I will not win ! :-(

Conclusions

- We are able to run simulations based on historical and real-time data on paths which are connected by nodes.
- We have in total analyzed and sorted at least 8 main parameters with relevant weights, 2 of which contributed to environmental and economic impacts on paths up to **n**-value sorting normalizations.
- We have outlined the most dominant factors in this project:
  - **Path coincidences, alternative routes, visualization, optimization and IDSS strategies based on historical and real-time datasets.**
- There are many potential add-ons that can be integrated to the software.

- Technologies:
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EU funded Research Projects

Project Name	Total Budget	BTH Budget
GOLNG (LNG Value chain for clean shipping, green ports and blue growth in Baltic Sea Region / Go LNG	2 200 000 €	200 000 €
CTCC (Creative Traditional Companies Cooperation – CTCC)	1 820 300 €	160 000 €
SIPort (Establishment of a network of Sustainable Innovative Ports in the South Baltic region)	1 700 000 €	240 000 €
Maritiime Compass (Improving Maritime Sector of the Baltic Sea Regionthrough Maritime Competences Tailored to Optimal Technological andLabour Market Performance	1 800 000 €	205 000 €
TOTAL	**5 320 300 €**	**795 000€**

*

Future ?

TEREX: DBIS, TBA

KALMAR: Interschalt , NAVIS, XVELA

Others...??

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