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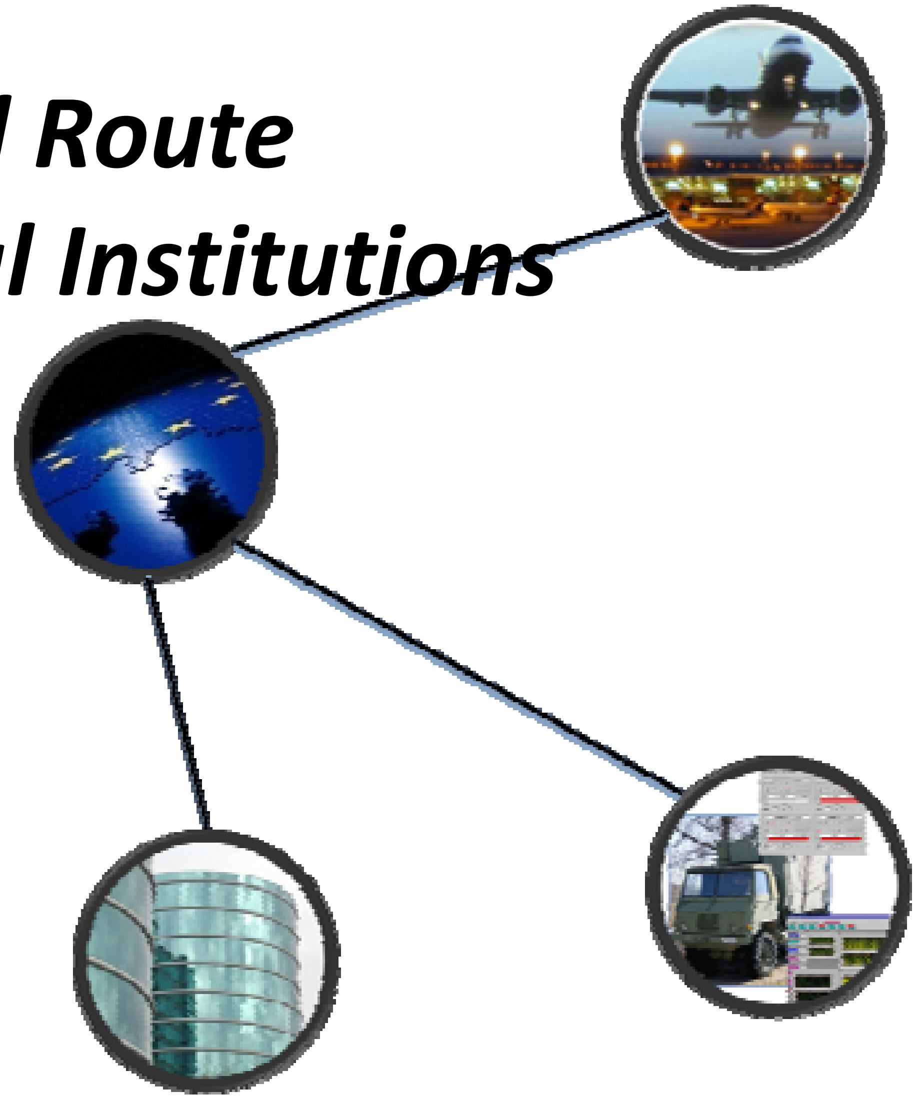
Cash Forecasting and Route Planning for Financial Institutions

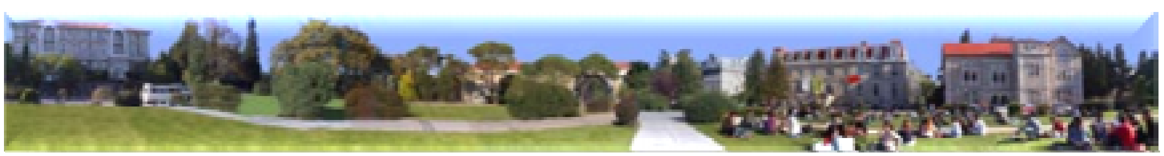


Dr. Tolga Kurt
PlusOneMinusOne
Dr. Emin Anarım
Boğaziçi University
Başak Öztaş
Boğaziçi University

PlusOneMinusOne Logistics

About P1M1

- R&D Organization building software on GIS based solutions. www.p1m1.com
- Located in Boğaziçi University Campus
- All algorithms are developed in-house
- Location based forecasting and optimization solutions
- Finance, Telecom, Logistics, Energy, Defense, Health and Airlines



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The Team

- 13 Software Engineers, 8 Ph.D. Level Researchers (Computer Science, Electrical Engineering, Math and Geography fields), 5 Senior University students, 3 MS Students composed of electrical engineers, industrial engineers and software engineers.
- Vast Experience in GIS based optimization
- ORACLE as Database Partner
- In-depth experience at Oracle based Integration
- ESRI as GIS partner
- Intel as Processing Partner

INTRODUCTION

- Each branch or money transaction point in a bank's network receives and gives money for operations throughout the day.
- This results in a circulation of money throughout the network.
- However, the money in this daily circulation may not be utilised in other operations such as investment. Hence there is potential loss of profits .
- In this project, an optimization software has been implemented such that branches may continue day to day operations effectively with minimum money circulation.
- This investigation may also lead to other optimizations such as optimizing branch locations and operations, and money distribution mechanism.

Airlines, Finance, Energy, Telecom

VARIOUS P1M1 SOLUTIONS

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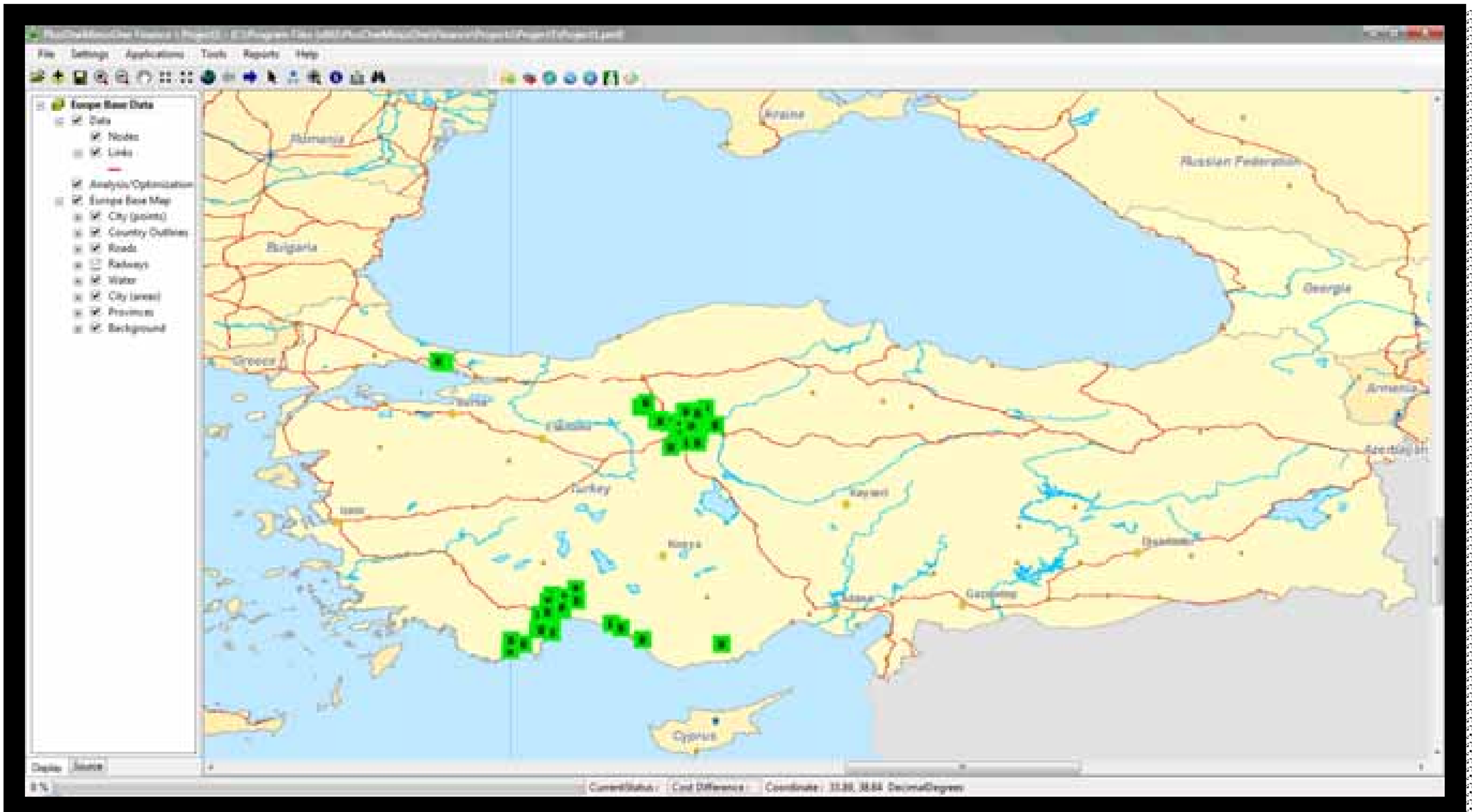
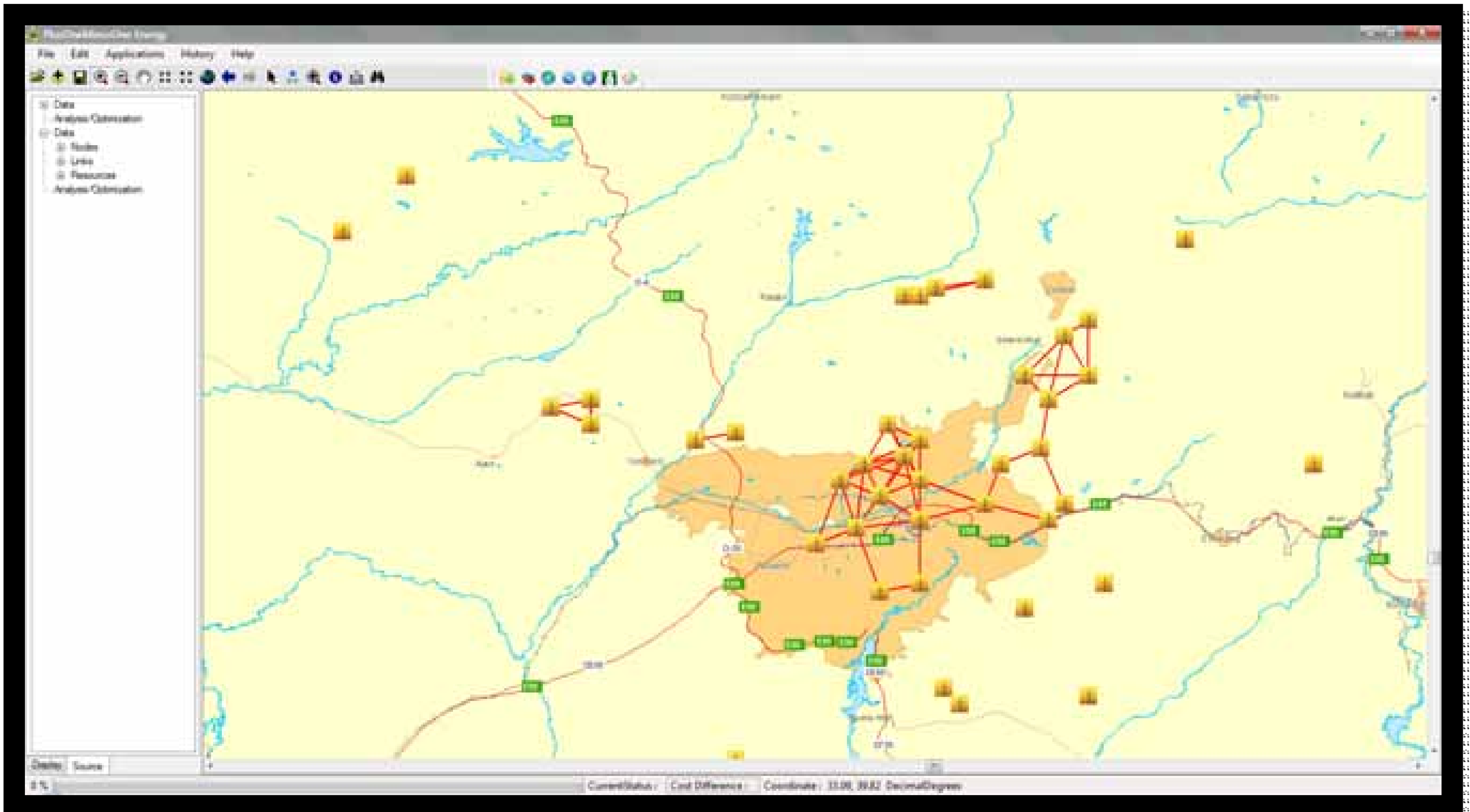
P1M1 AİRLINE

P1M1 FINANCE



P1M1 ENERGY


File
Edit
Applications
History
Help
Data
Analysis Optimization
Nodes
Links
Resources

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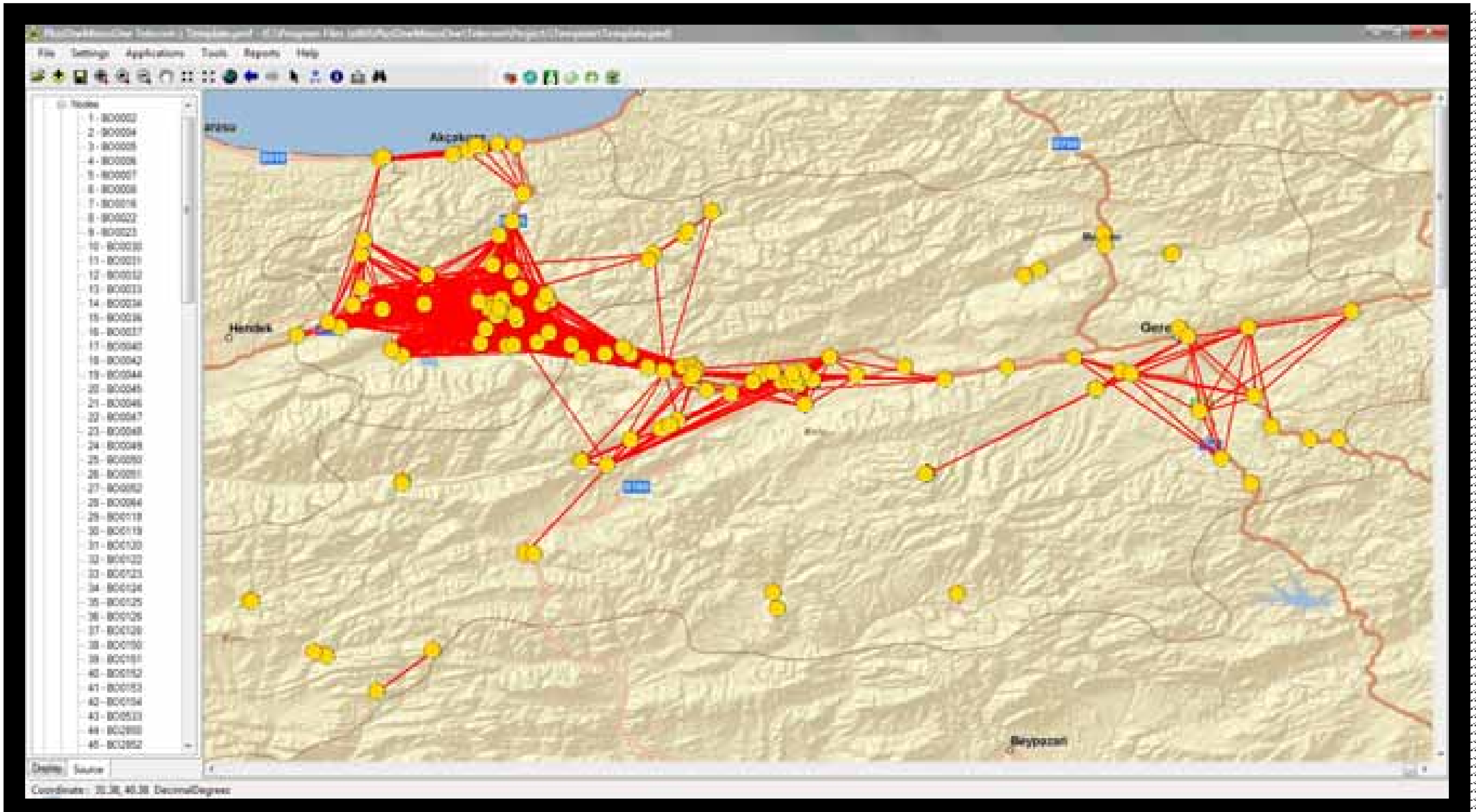
P1M1 TELECOM



OBJECTIVE

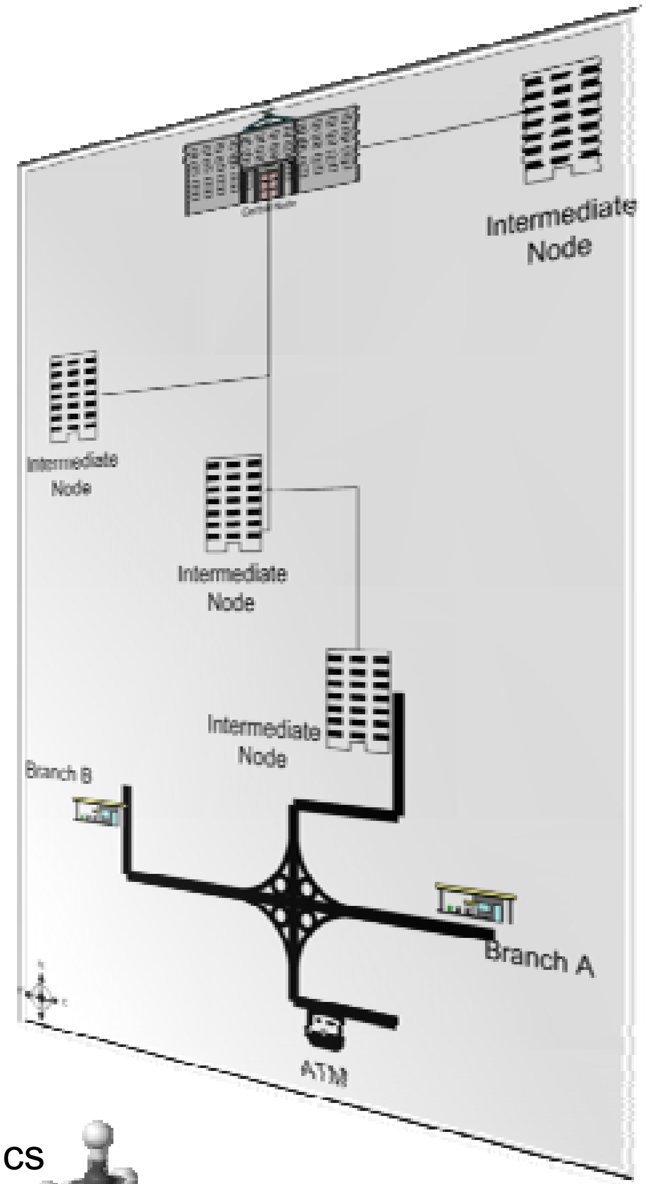
To **predict**, **plan** and **forecast** the amount of cash replenishment level in branches and ATMs for efficient operation.

Accurate estimates are critical !!!

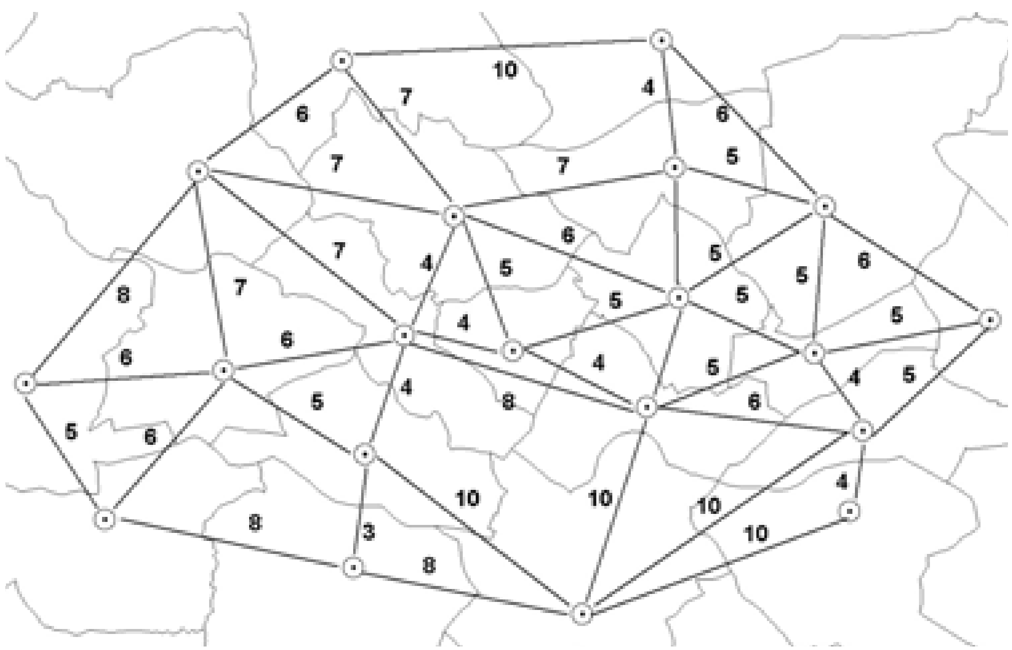
- More idling cash → Increased opportunity cost
- Insufficient cash → Intangible loss (Damage of goodwill, loss of customers …)

System Model

- In the system, there are nodes with different levels, which are connected geographically with each other.
- This can as well be represented by a directed graph network with various distance parameters.

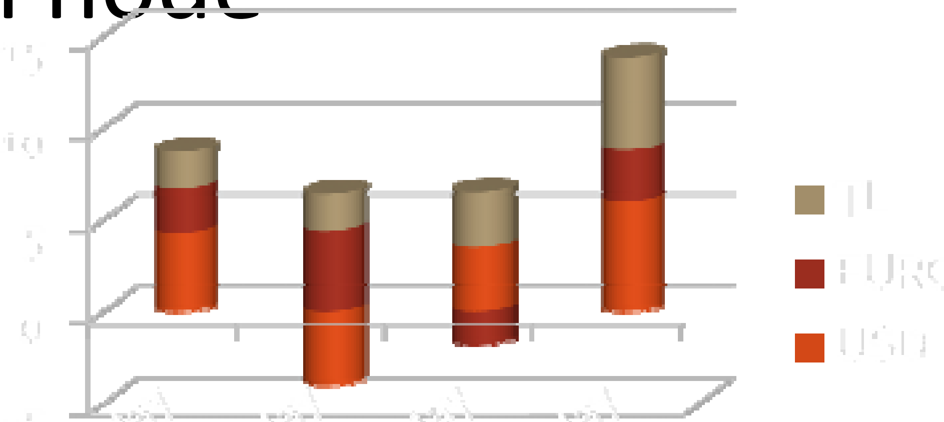


Distribution network



- In the system, each node has a weight
- Each node is connected to a subset of nodes
- Each has a geographical locations and underlying demand structure
- A GIS based solution enables
  - Utilizing location knowledge
  - Utilizing underlying data such as population, census data, etc.

Issue 1 Find the expected demand of each node



- Each branch or money transaction point is a node in the graph and has a history of demand and supply of money.
- By looking at the historical data, for each day, depending on parameters such as season, day of the month, and special events an estimate of net flow of money can be estimated before hand.
- This estimation need to have a confidence level in order to guarantee normal operations of a node in the network.
- This will make sure no excess money injected to the system
- This will be repeated for all nodes for all currencies

Issue 2 Identify the node needs

- Each node now has an expected demand and the balance of last date for each currency, which gives the expected demand or supply for the next day

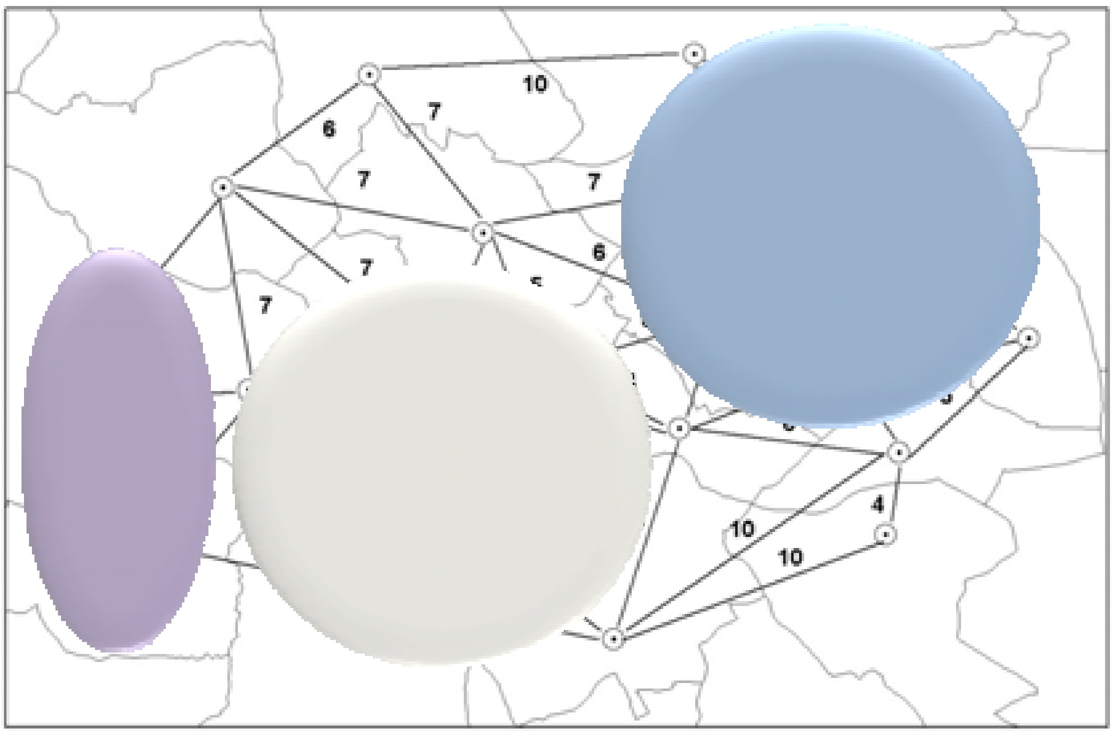
54000TL expected surplus

30000 USD expected demand

Issue 3 Re-using the money

- If one can identify a geographical area, where the total expected supply and demand are close to each other, then the money can be exchanged within. This decreases the need of injection of money to the system
- This brings us to the money island detection problem. Each island can be defined as a group of nodes, where the internal money transfer demand is significantly higher then injection or export demand.
- Selecting the best island set is import because:
  - it can decrease the amount of money transfer
  - İt can decrease the transfer costs and risks by geographically limiting the transfer area

Issue 3 Identification of the node needs - islands



Issue 4 Optimizing Money Flow

- Finally for each currency, the daily money flow should be decided for the whole network by utilising money islands.
- The optimization criteria could be different such as:
  - Minimize the risk
  - Minimize the total money circulation
  - Minimize the risk of interception

- The optimization should satisfy some limitations as well:
  - Number of transfer trucks
  - Travel time between nodes
  - Total money available to the system

Solutions - I

- Issues 1-2 are a stochastic expectation problem
- Issues 3-4 are NP-hard problems which are also known as island detection problem and multi-traveling salesman problem with time constraint and cost fuction
- NP hard problems are very complex problems where the exact solution cannot be found but needs to be heuristically estimated.
- P1M1 provides a unique Matching Pursuit (MP) based optimization algorithm in order to minimize the convergence time and optimal converged point.

Formulation of Gain

- Node Closing at time t-1 is **y**.
- It is estimated you need 90% **0.8y** tomorrow.
- You save **0.2y**
- For 2-3 days a month, the node asks for extra money.

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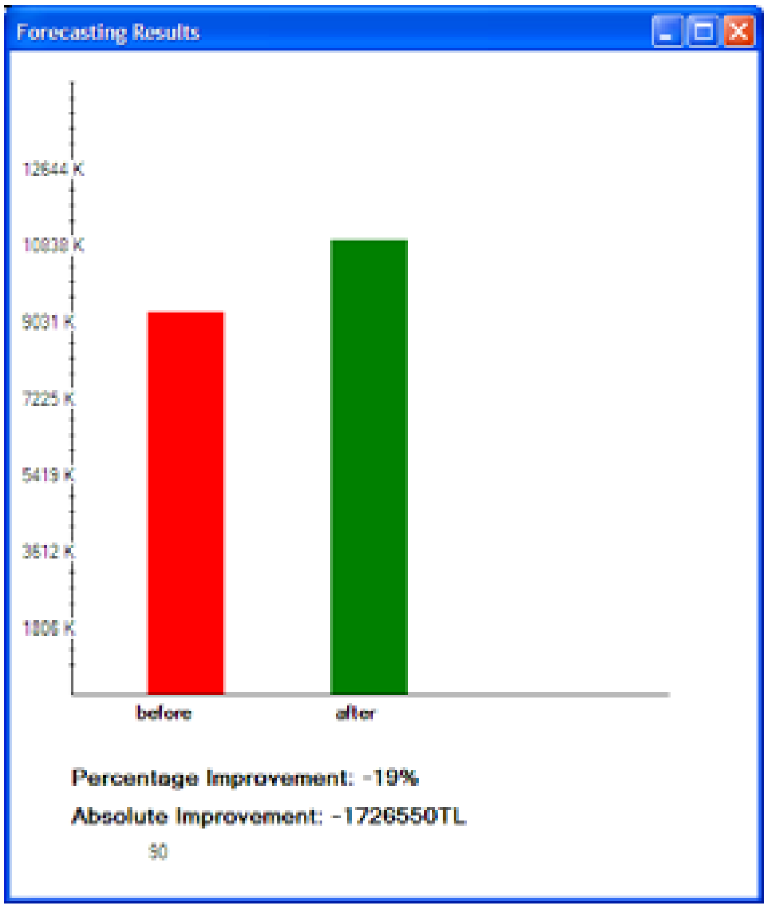
Obvious way is not the way



%90 Histogram Analysis results in loss!!

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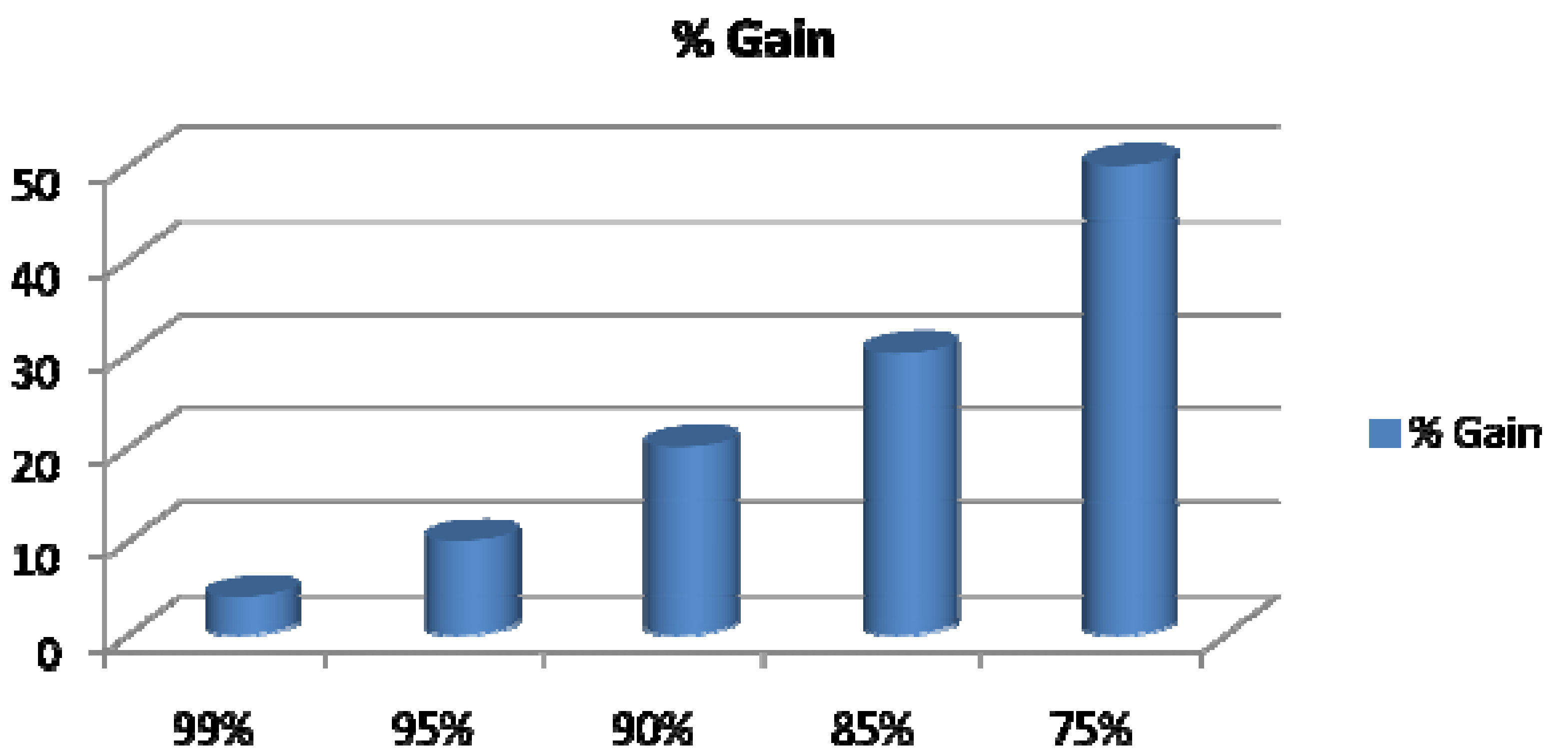
% Gain vs. Self Sufficiency



Island detection benefits excluded

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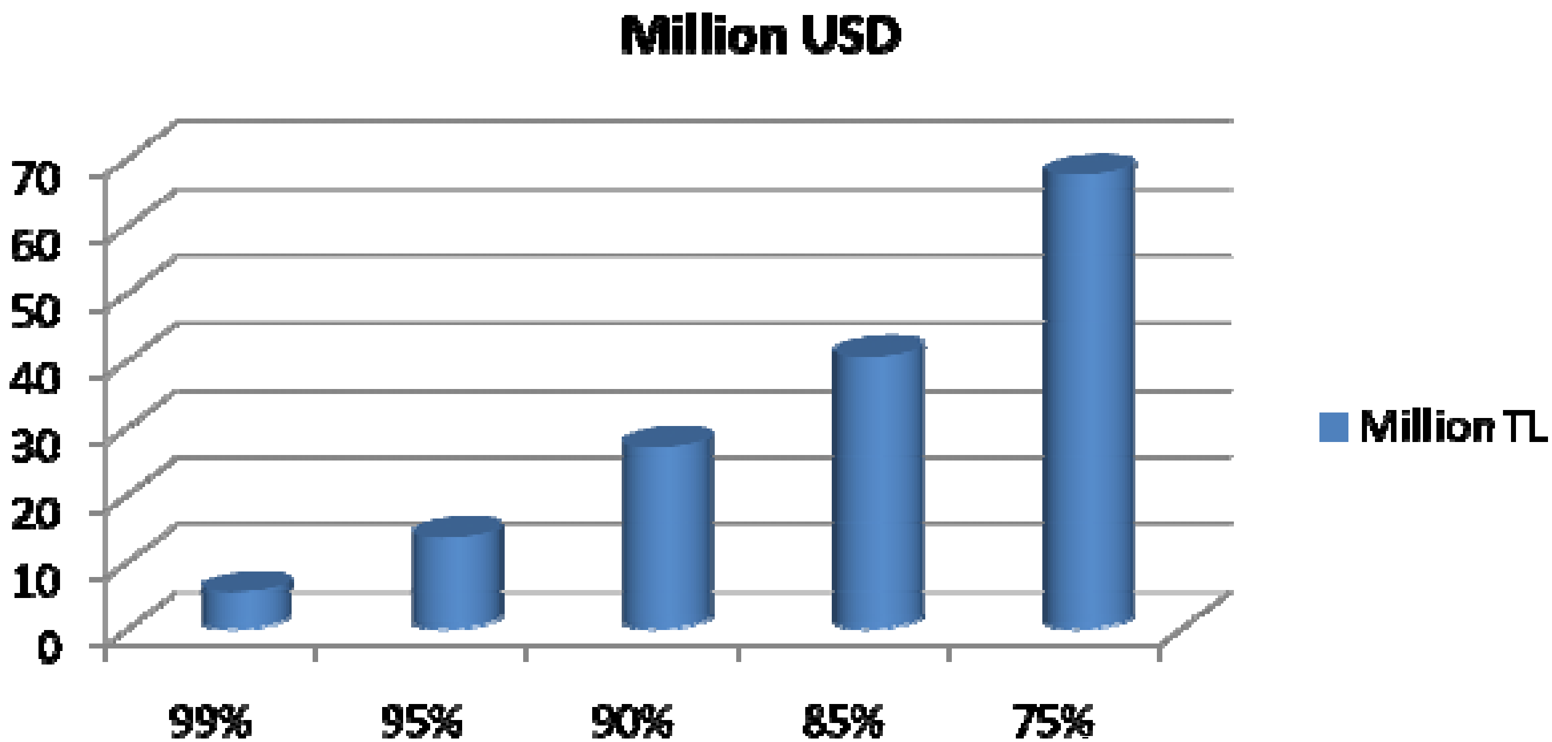
1000 Node Gain vs. Self Sufficiency Rate



Island detection benefits excluded – Money Insurance benefits exluded
The gain is linearly scaled from 73 nodes to 1000 nodes

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Algorithms for a better future...

www.p1m1.com

contact@plusoneminusone.com

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