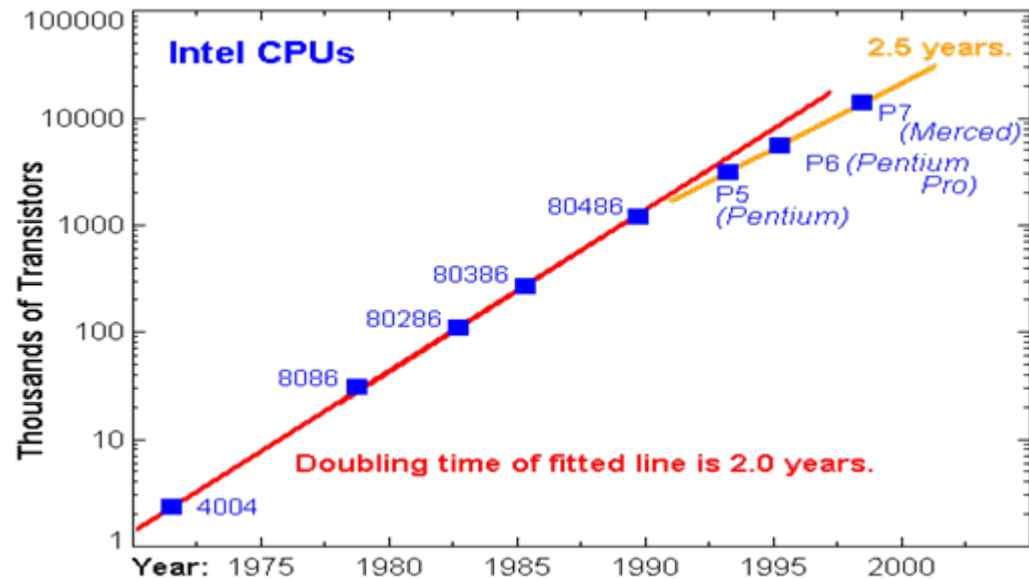


# Methods

## Moving on from Forecasting to Foresight: but how?



<http://www.physics.udel.edu/~watson/scen103/intel-new.gif>

January 4, 2010

# Types of methods

- Monitoring, trend watching
- Historical methods
- Extrapolation
- Analogies
- Modeling
- 'Expert' methods: interviews, Delphi
- Experiments

# Foresight Methods

## Monitoring

Study of:

Professional journals

Patents/patent trends

Searches

Websearches

Meetings

Annual reports/media

# Foresight Methods

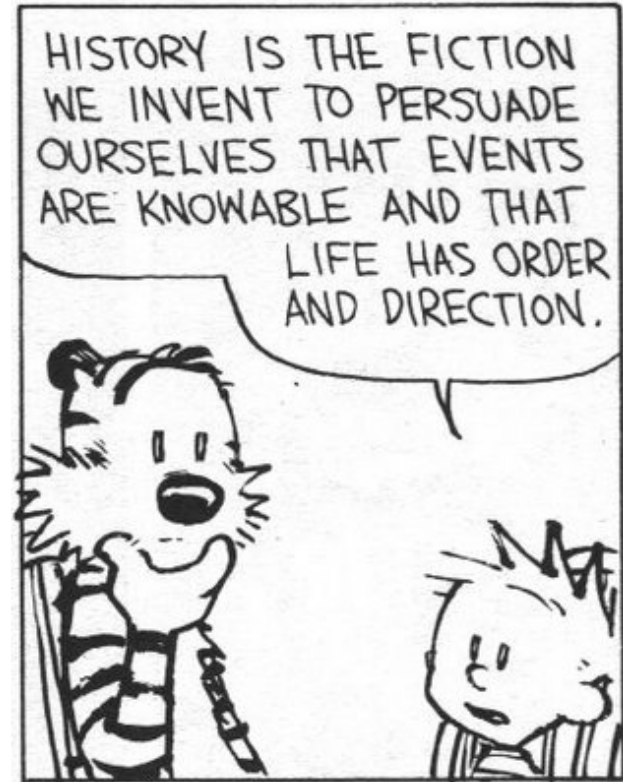
## Historic Methods

Presupposition: historic parallels

Historic analogy

Diffusion curves

S-curves



<http://i14.photobucket.com/albums/a321/Mattpmx/CalvinHobbesHistory.jpg>

# Foresight Methods

## Extrapolations

Based on hypotheses such as

- Linear growth

- S-curve

- Envelope curve

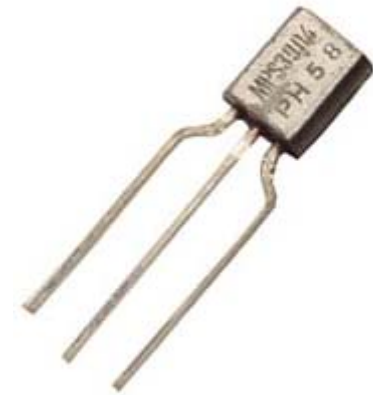
- Fisher-Prey, Gompertz diffusion models

# Extrapolations

## Moore's Law

Trend describing that the number of transistors that can be placed on an integrated circuit is increasing exponentially, and doubles approximately every two years

The trend was first observed in 1965 paper. It has continued for more than half a century and is not expected to stop for at least the next decade

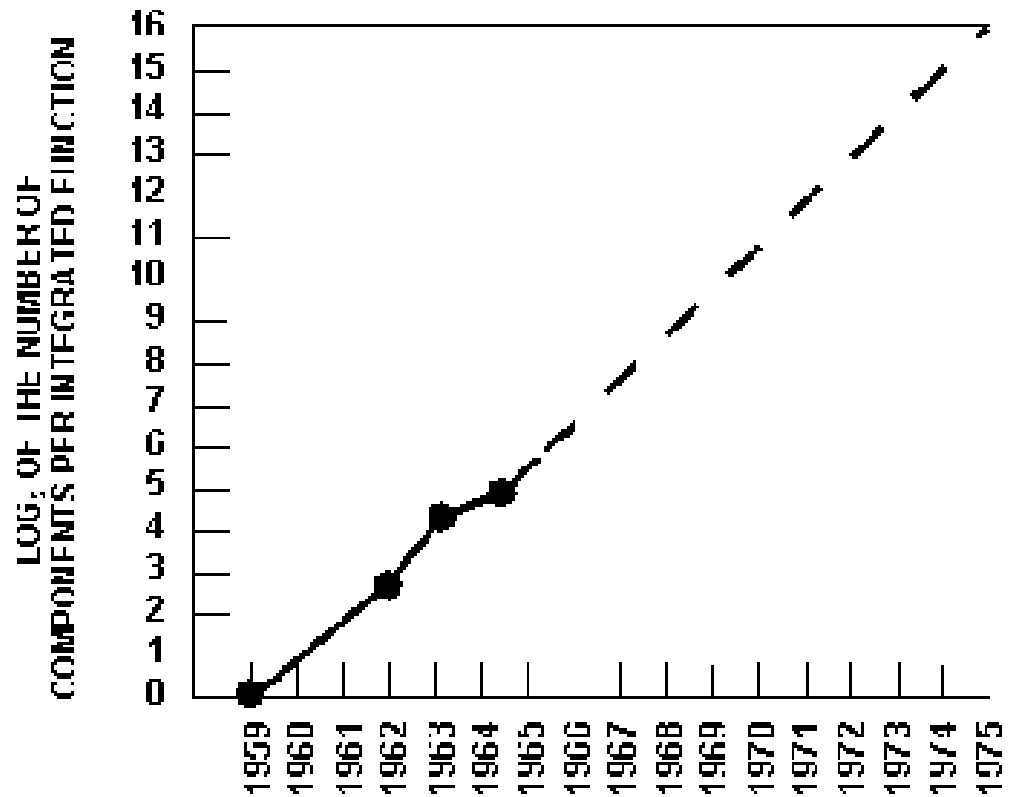


<http://www.opamp-electronics.com>

# Extrapolations

## Moore's Law

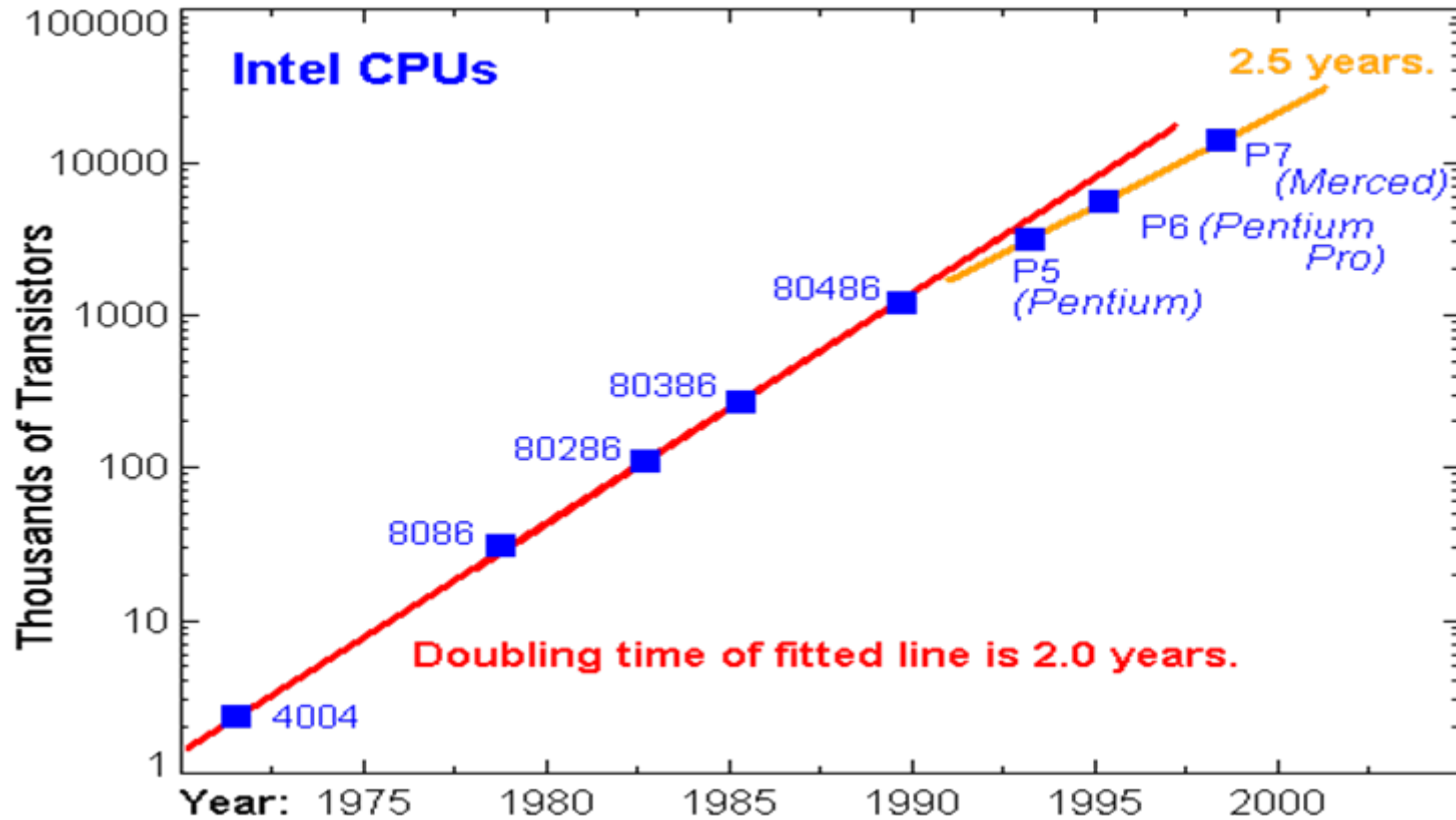
The original Moore's law plot



Electronics, April 1965

# Extrapolations

## Moore's Law



<http://www.physics.udel.edu/~watson/scen103/intel-new.gif>



# Extrapolations

## Moore's Law

Based on extrapolation it is clear that c-mos technology will grow less fast within 5 years as physical limits will be reached (quantum effects)

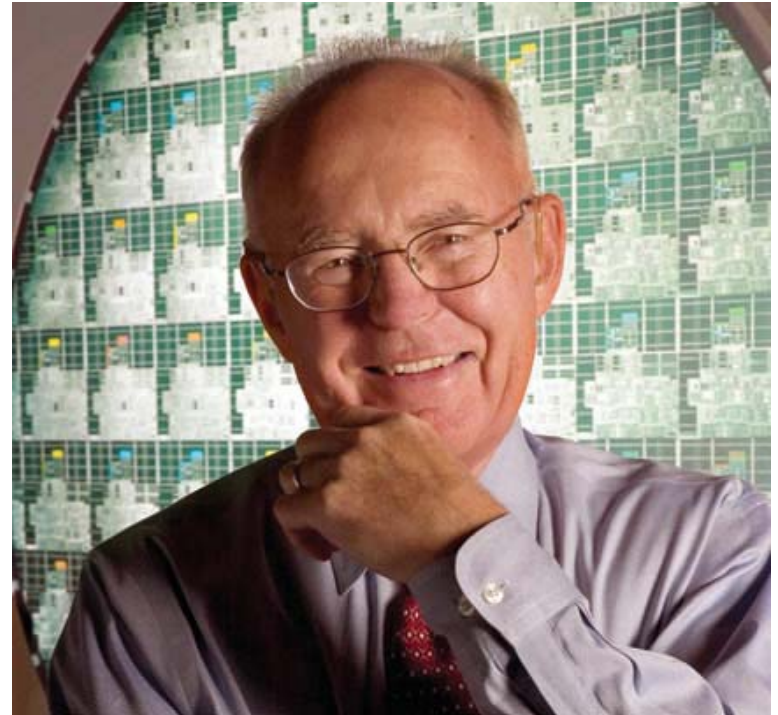
Further growth can only be achieved by switching to another basic technology (regime switch)

# Extrapolations

## Moore

- Moore is not only an empirical description
- Moore was the co-founder of Intel
- It took 4-5 years to develop new chips

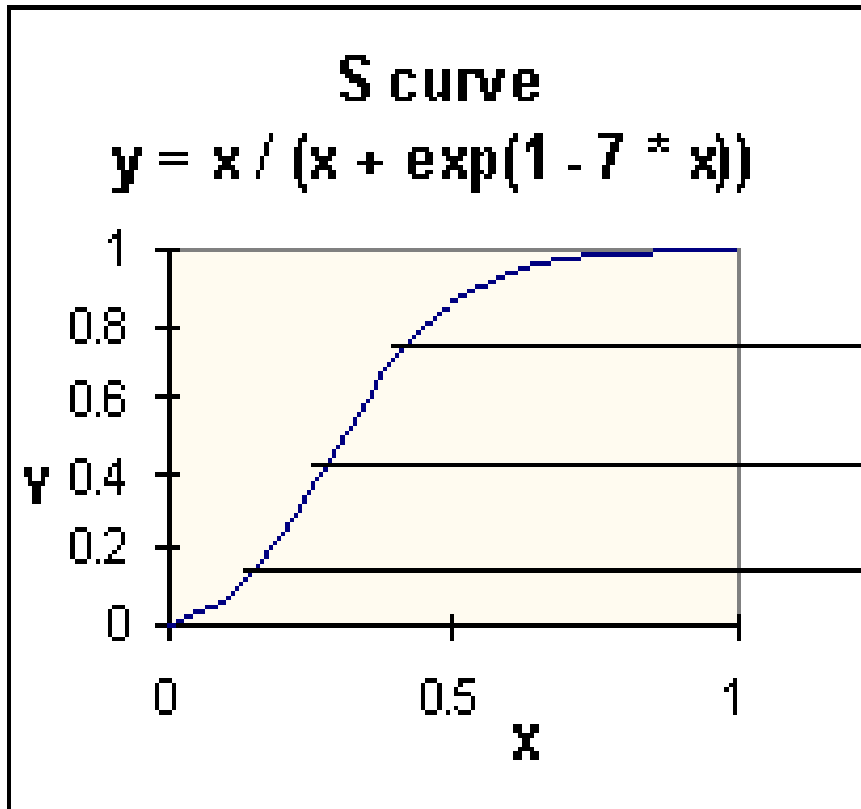
Companies used Moore's law in their research planning



[www.automationnotebook.com](http://www.automationnotebook.com)

# Foresight

## S-curve



declining slope  
inflection point  
exponential portion

# Foresight Methods

## Expert Methods and Bias

Expert methods:

If there are no reference points for extrapolation



<http://www.flug-revue.rotor.com/FRheft/FRH9809/FR9809K1.JPG>



Hydrogen as aircraft fuel?

# Foresight Methods

## Expert Methods and Bias

Positive bias technology in general  
e.g in IEEE research

Positive bias in area of own expertise  
e.g in nuclear fusion, self-selection

# Foresight Methods

## Expert Methods and Bias

Social structure within disciplines prevents open communication:

Dependencies

Interests/benefits

Biases

Delphi method



# Foresight Methods

## Delphi Method

Delphi:

Survey among experts in several rounds

Anonymous feed back of arguments & estimates

Revision of judgments

Consensus in 3-4 rounds



Wikipedia: Pythia1.jpg

# Foresight Methods

## Delphi Method

Used since 1959

Good results,

Not just forecasting: it is also intervention in a discipline

### **But, criticism:**

- Group bias remains

- Strategic behavior by mutual contact

- Only for experts within a discipline



# Delphi Method

## Examples

External propulsion of vehicles

50 experts (global, 50% return, variatie)

14 technologies

4 technologies were promising

Many experts changed their view during Delphi process

# Delphi Method

## Examples

Misjudgment of:

Speed of Technological change

(1950s, flying cars)

Expert assessment of technologies

(1970s regarding synthetics to be superior)

Citizens judgments

(nuclear power)

Public policy

(glass recycling)



<http://www.svm-pact.nl>

# Scenarios

## Forecasting

Considering future possibilities

Generally when developments are too complex for simple predictions

NOT: predicting catastrophe relief measures

BUT: plausible and coherent contexts that could occur and stimulate creativity



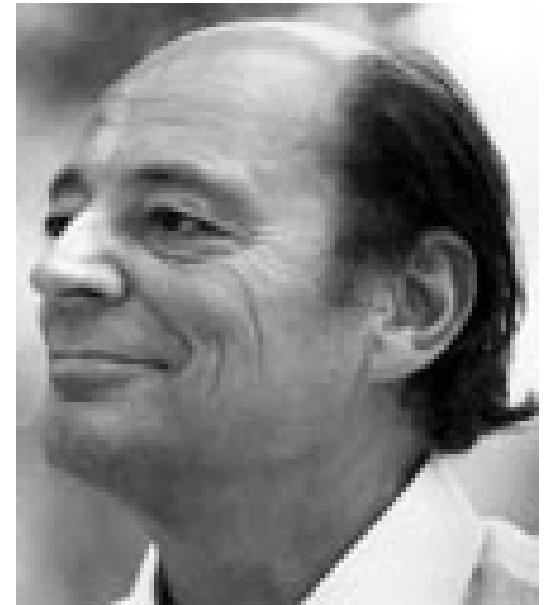
<http://www.atout-guadeloupe.com/>

# Scenarios

Pierre Wack

During **stable times**, the mental **model** of a **successful decision maker** and **unfolding reality match**.

In times of **rapid change** and **increased complexity**, however, the manager's mental model becomes a **dangerously mixed bag**: rich **detail** and **understanding** can coexist with **dubious assumptions** and **illusory projections**. (Wack, 1985)



<http://www.gbn.com/images>

# Scenarios

## Ingredients

Technology

Economics

Demography

Culture

Regulation

Environment

Competition

# Scenarios

## 6 Choices

Quantitative or Qualitative

Descriptive or Normative

Projective or Prospective

Exploring or Explaining

No surprises or New perspectives

External or Internal

# Scenarios

## Requirements

At least 2 scenarios

Plausible

Internal consistency

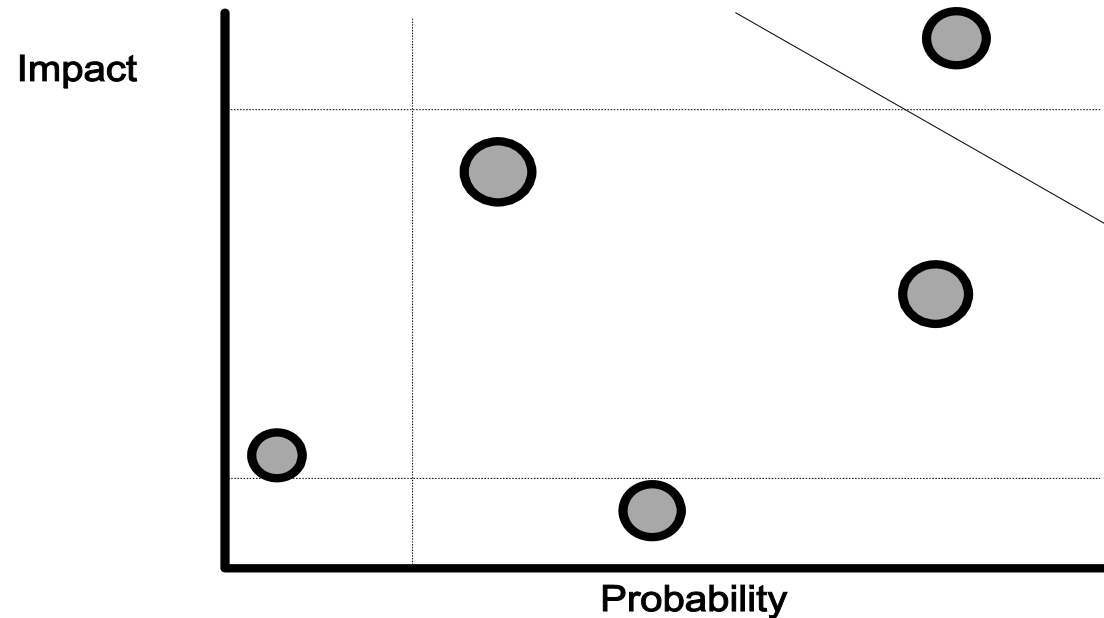
Relevant in scope and time

Original

# Scenarios

## Requirements

Relation between impact and probability





# Scenarios

## Results

In terms of effects and consequences

If it leads to disasters → manage change

If it is vulnerable → monitoring

# Scenarios

## Results

In all scenario's, the corporation meets its goals.

In all scenario's, the corporation does not meet its goals.

In a surprise free scenario, the corporation meets its goal, but not in other scenarios.

In a surprise free scenario the corporation does not meet its goals, in alternative scenarios, it does.

# Scenarios – Example

## The Panama canal

Between the Atlantic and Pacific Oceans  
Approximately 80 kilometers long.

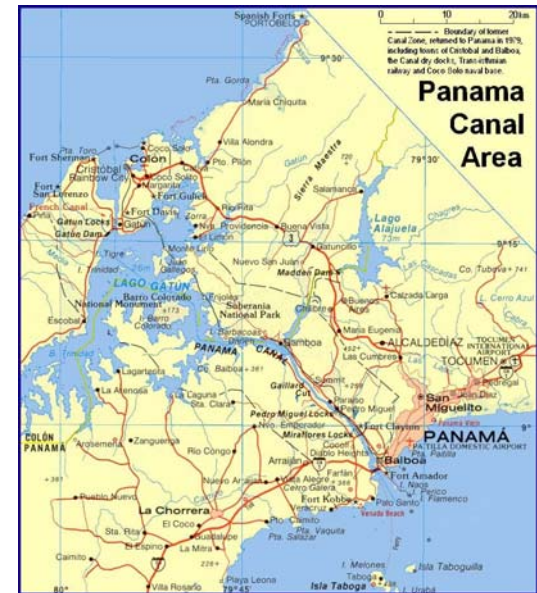
Maximum dimensions of ships:

32.3 meters in beam;

12 meters in draft in tropical fresh water;

294.1 meters long

Narrowest portion, 13.7 kilometers long, is carved through the rock and shale of the Continental Divide.



<http://lostparadise.com/maps>

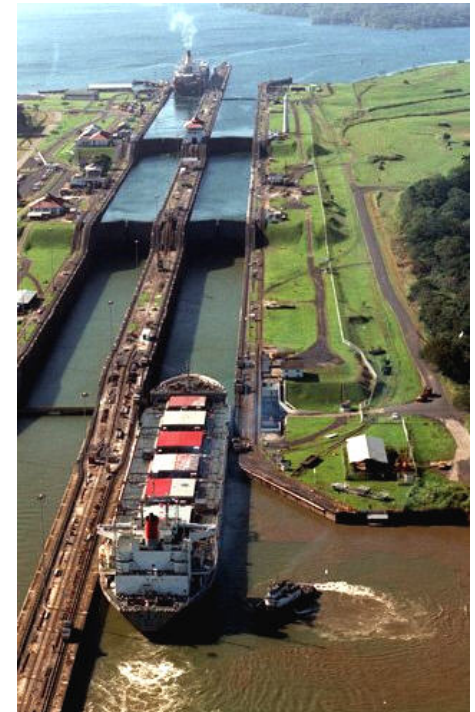
# Scenarios – Example

## The Panama canal

13 to 14 thousand vessels every year: 5% of the world trade.

Work force of approximately 9000 employees, 365 days a year,

Providing transit service to vessels of all nations without discrimination.



<http://www.photoatlas.com>

# Scenarios – Example

## The Panama canal

\$1-billion to modernize and improve.

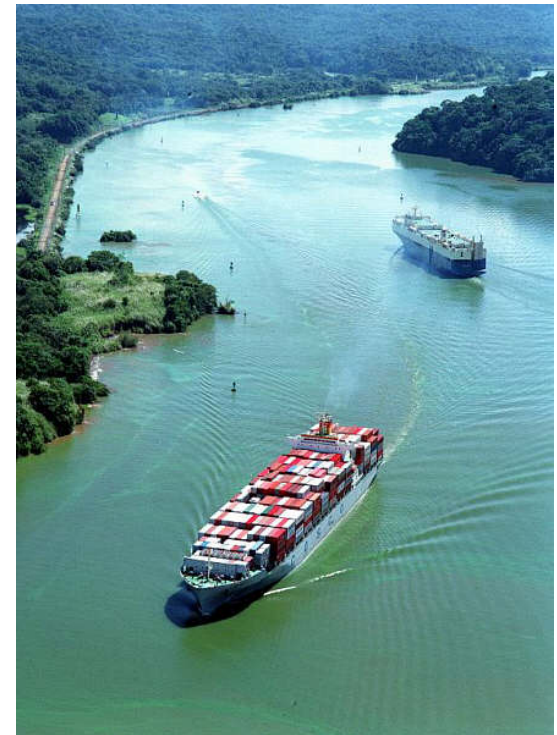
Meet traffic demands and provide quality transit services.

Investment of over \$100 million annually.

\$700 million to be implemented by the Panama Canal Authority.

U.S. Army Corps of Engineers review Canal's physical plan.

Improvements to ensure the waterway remains viable and competitive



<http://www.photoatlas.com>

# Scenarios – Example

## The Panama canal

How to forecast future shipping  
(quantity and size)?

What are main variables for your estimate?



<http://www.photoatlas.com>