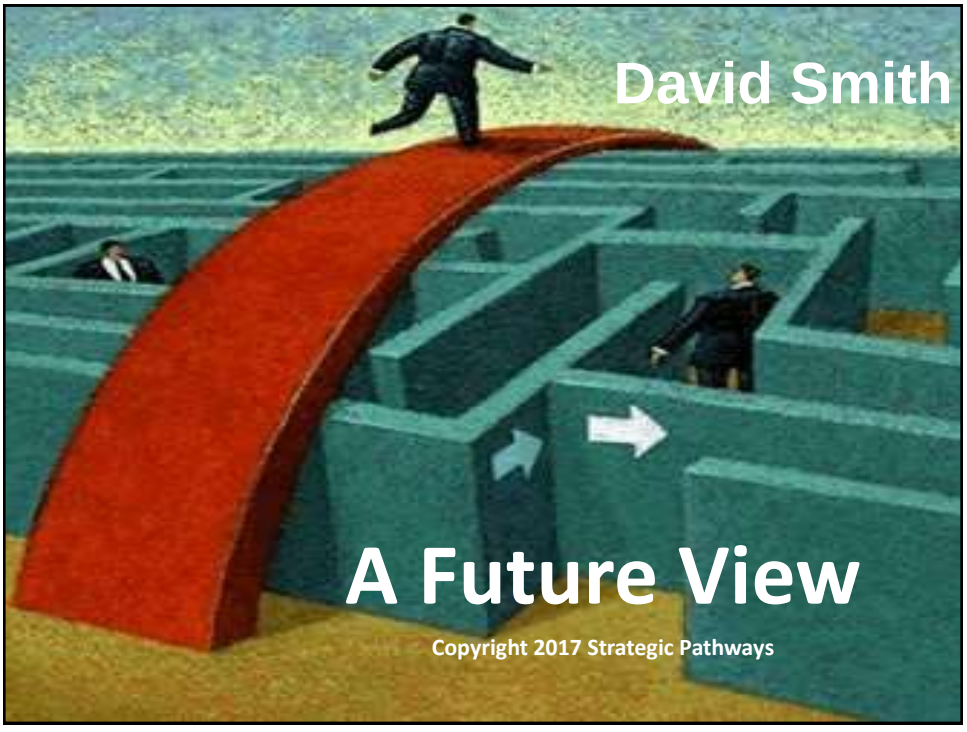



## The World We Live In—Global Changes

**Faster, More Complex, Brittle**

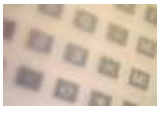
***Examples:***

- **Connectivity** — Connectivity all the time, everyplace
- **Biotechnology** — Global Destabilization due to AIDS
- **Geopolitical** — "Meaning communities" confuse concept of national loyalty
- **Extraterrestrial Event** — Extraterrestrialization of civilization
- **Societal** — Commercialization of government services
- **Energy** — Switch to hydrogen economy
- **Technology** — Nanorobotics
- **Education** — Reduced foreigners in U.S. academia
- **Physical Environment** — Geospatial changes affect current databases
- **Knowledge** — Exponential data explosion
- **Economics** — Integration of IT based global markets
- **Conflicts** — Conflicts over Resources
- **Resources** — Resource shortages from growth
- **Demographics** — Most growth at poorest/unstable spots

***...and alternative scenarios***

# Technology—Webster's

- The science of the practical or industrial arts
- Applied science
- A method of achieving a practical purpose
- The totality of the means employed to provide objects necessary for human sustenance and comfort





# What is Technology?

***"Application of knowledge to objectives"***

—J. P. McTague, "Wielding a Three-Edged Sword,"
*Federal Lab Technology*
*Transfer: Issues and Policies* (1988)

## Why View the Future Through Technology Trends?

They provide a yardstick to place and mark the changes and growth, much as our parents did when we were growing up.

## Three Forecasting Tasks

- Select a technology
- Make projection
- Use results

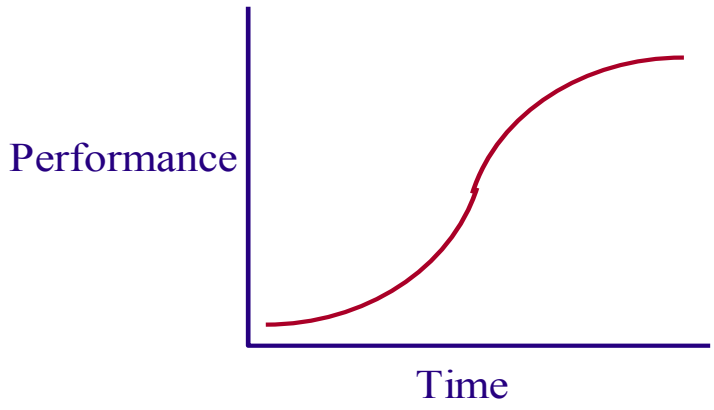
# Customers

- Present
- Defined Potential
- Undefined Potential



# Goal of Technology Advantage Management

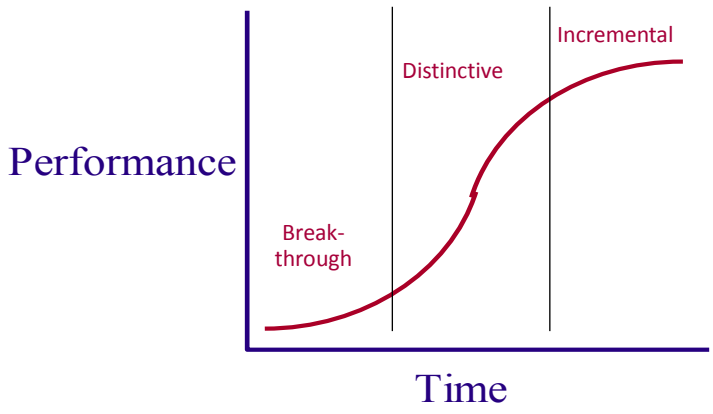
- ***Keep*** Present Customers
- ***Capture*** Defined Prospective Customers
- ***Create*** Undefined Prospective Customers





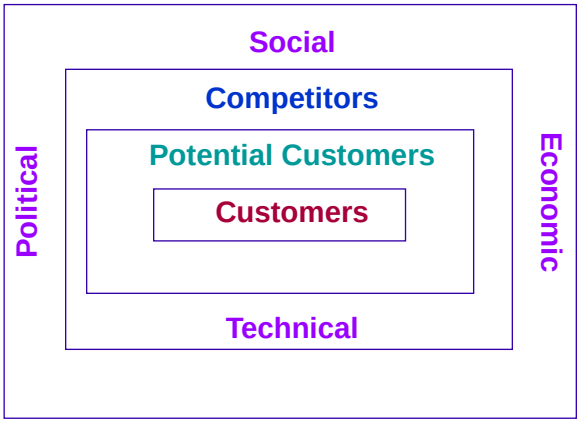

# Degree of Technology Advantage

- **INCREMENTAL** innovations are those that reflect a relatively small improvement over present Products, Processes, and Procedures. These are advances that are a little better, a little faster, a little cheaper.
- **DISTINCTIVE** innovations are those that provide significant advances or improvements, but that are not based on fundamentally new technologies or approaches.
- **BREAKTHROUGH** innovations are those that are based on fundamentally different technologies and approaches—and that allow the performance of functions that were previously not possible, or the performance of presently possible functions in a manner that is strikingly superior to the old.





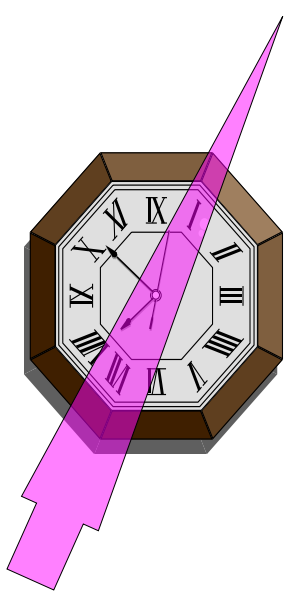

# Business Environment

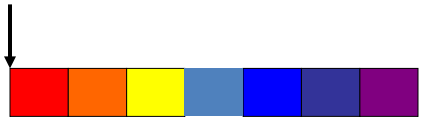


# Six Views of the Future

- **Extrapolator**
- **Pattern Analyst**
- **Goal Analyst**
- **Counter Puncher**
- **Intuitor**
- **Artist**







## Extrapolator

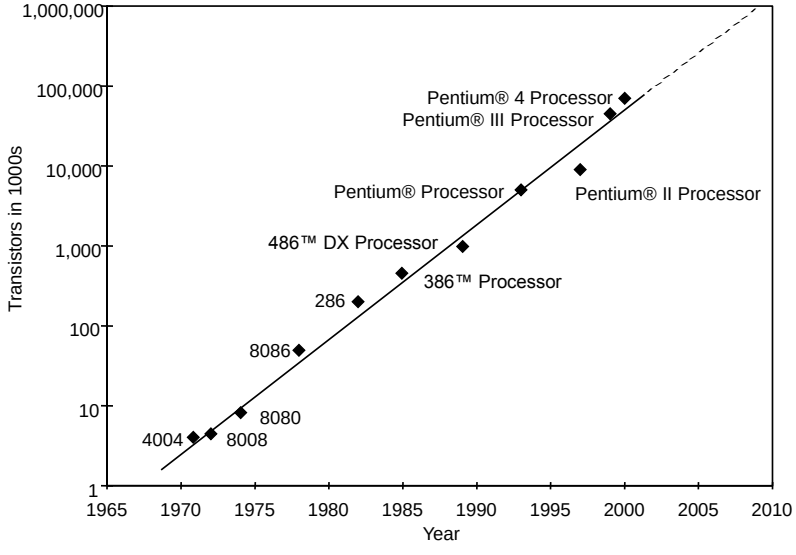
- Future is logical extension of past
- Reasonably predictable
- Use trend analysis

# Extrapolator Techniques

- Technical Trend Analysis**
- Fisher-Pry Analysis**
- Gompertz Analysis**
- Growth Limit Analysis**
- Learning Curves**

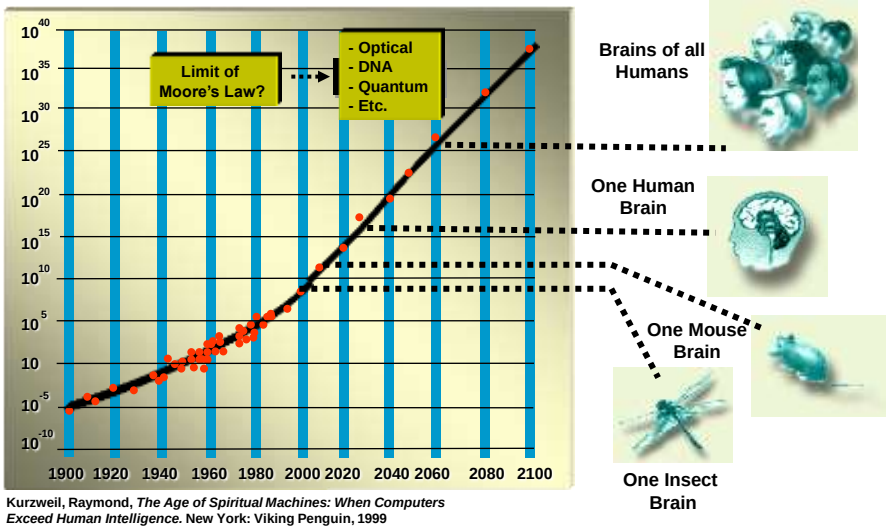
** Quantitative
* Semi-Quantitative

# Moore's Law



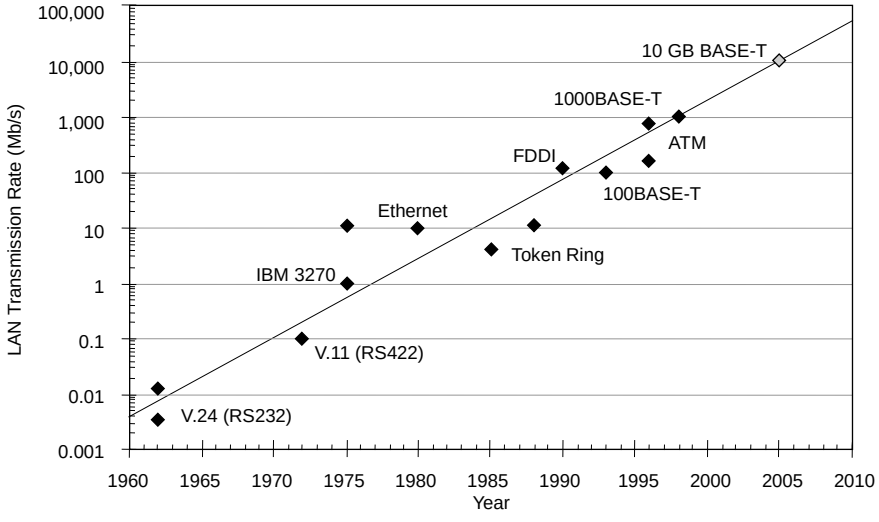
# Driving Force: Moore's Law

**(Calculations per Second bought by $1,000)**

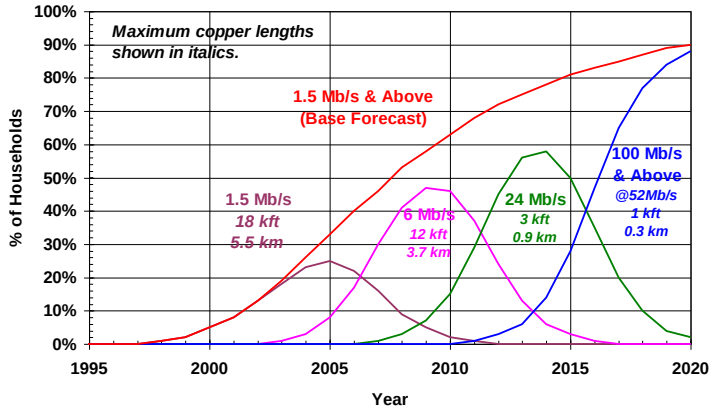



Kurzweil, Raymond, *The Age of Spiritual Machines: When Computers Exceed Human Intelligence.* New York: Viking Penguin, 1999

# LAN Transmission Rates

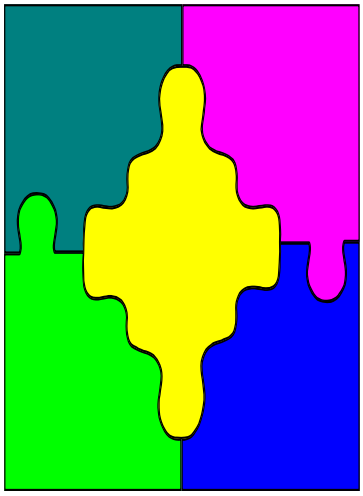


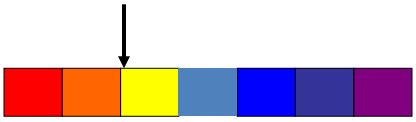
# Percent of U. S. Households with Broadband




# Characteristics of Extrapolator Techniques

- Valid when basic situation well defined
- Most useful when quantitative projections needed
- Requires accurate data
- Valuable in defining important questions
- **Problems when driving forces are in flux**





## Pattern Analyst

- Future is replication of past events
- Identify and analyze analogous situations from the past



## Pattern Analyst Techniques

- Analog Analysis*
- Precursor Trends Analysis**
- Morphological Analysis
- Feedback Models**

** Quantitative
* Semi-Quantitative

# Morphological Analysis to Identify Innovation R&D Projects for an Electrical Metering System

| Function | System | | | |
|---|---|---|---|---|
| | Present Standard | Customer Manual | Thermal Watt-Meter | Electronic System |
| Sensing | Induction Coils | Note On-Times for Each Known Load | Resistance Heating | Magnetic Flux Sensor |
| Collecting | Revolution Center | Add On-Times for Each Known Load | Time-Temperature Record | Micro-processor |
| Converting | Gears | Multiply Total Time for Each Load by Load Size | Scalar Equivalent | Micro-processor |
| Comparing (Standardizing) | Comparison with Laboratory Standards | Calibrate Each Load | Test with Known Electrical Inputs | Process Control |
| Recording (Memory) | Angular Position | Paper and Pencil | Angular Position | Integrated Circuit |
| Display | Pointers | Paper and Pencil | Pointers | Liquid Crystal Display |
| Transmission | Meter Reader | Postal System | Meter Reader | Live Carrier |
| Transfer (to Records) | Clerk/ Keyboard | Clerk/ Keyboard | Clerk/ Keyboard | Videodisc |
| Verification | Customer | Area Load-Summing | Customer | Point-of-Service Memory vs. Central Memory |
| Control (e.g., Feedback) | Customer Switching | Customer Switching | Customer Switching | Line Carrier Control |

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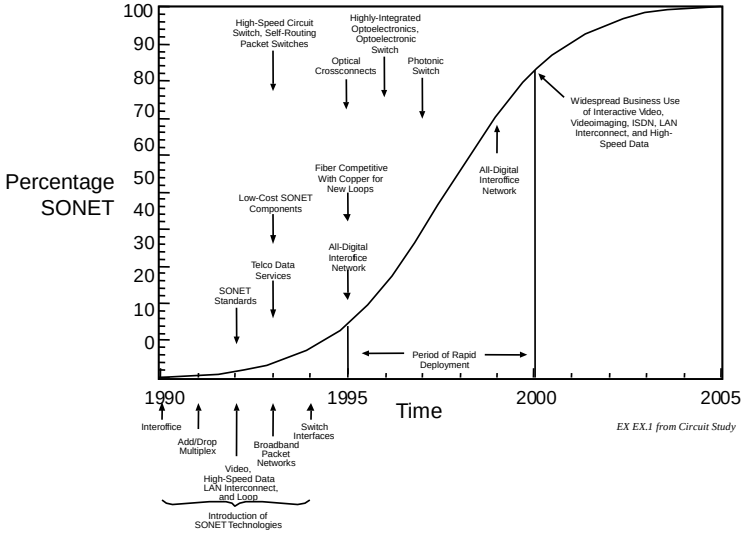
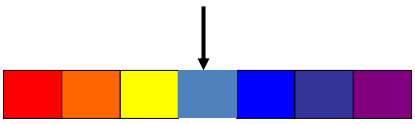
# Forecast of SONET Penetration into the Network with Likely Dates of Key Events

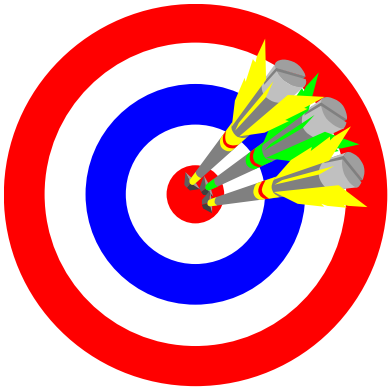


# Characteristics of Pattern Analyst Techniques

- Valid when truly analogous examples exist
- Most useful when change is just starting
- Better to examine more than one analogy
- Driving forces must be understood
- **Problem when dissimilarities not recognized**







## Goal Analyst

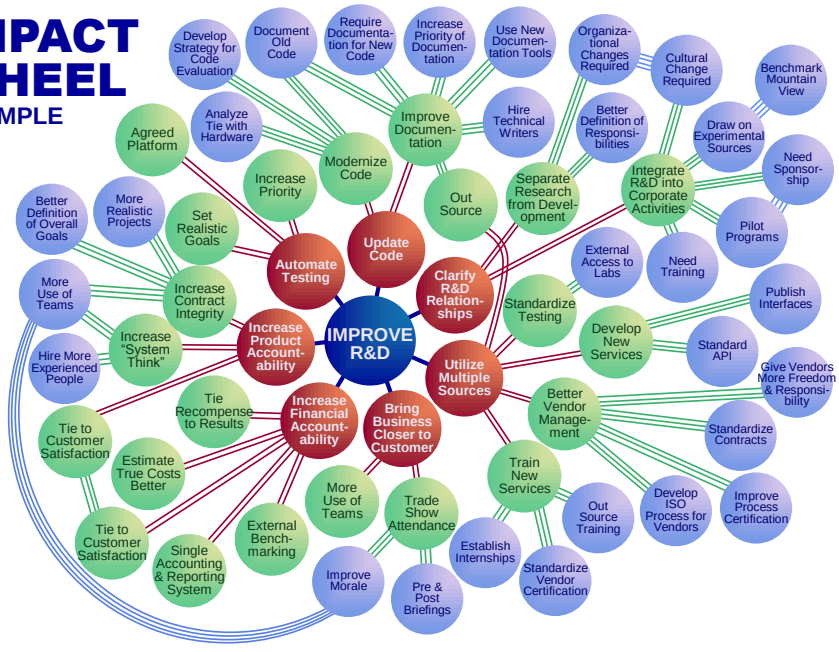
- Future is determined by certain individuals, entities
- Identify the decision makers and trendsetters
- Use impact analysis

# Goal Analyst Techniques

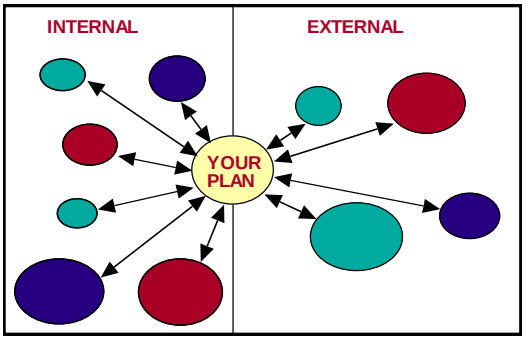
- Impact Analysis
- Content Analysis*
- Stakeholder Analysis
- Patent Analysis*
- Roadmaps
- Value Chains

** Quantitative
* Semi-Quantitative

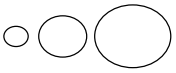
## IMPACT WHEEL
EXAMPLE



# Stakeholder Perception Map




SIZE OF IMPACT:

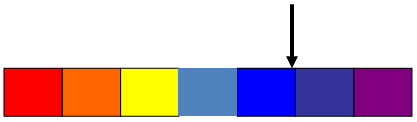


TYPE OF IMPACT:

- STAKEHOLDERS WITH POSITIVE POSITION
- STAKEHOLDERS WITH NEUTRAL POSITION
- STAKEHOLDERS WITH NEGATIVE POSITION

# Characteristics of Goal Analyst Techniques

- Useful when exogenous factors of consequence
- Key stakeholders often overlooked
- Logic of opposition may not be apparent
- Passion seldom overcome by greater passion
- **Problems when stakeholders not well defined**



## Counter Puncher

- Future is random
- Identify many possibilities
- Monitor developments
- Be flexible



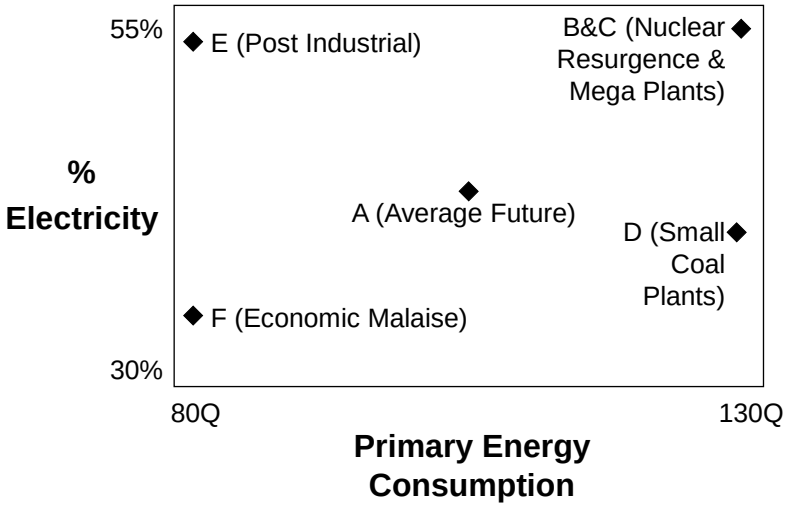
## Counter Puncher Techniques

- Scanning, Monitoring, Tracking
- Scenarios*
- Terrain Mapping*
- Decision Trees**
- Strategic Games*

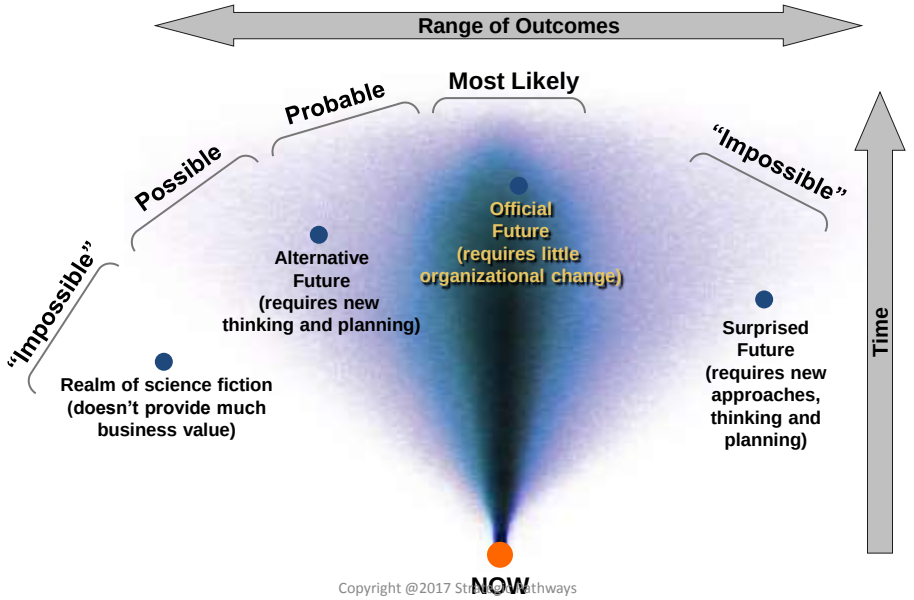
** Quantitative
* Semi-Quantitative

A scenario is a coordinated set of assumptions about how the future may develop, used to assist in organizational planning.

## Endpoints Year 2030, Scenarios A-F



# Credible But Challenging





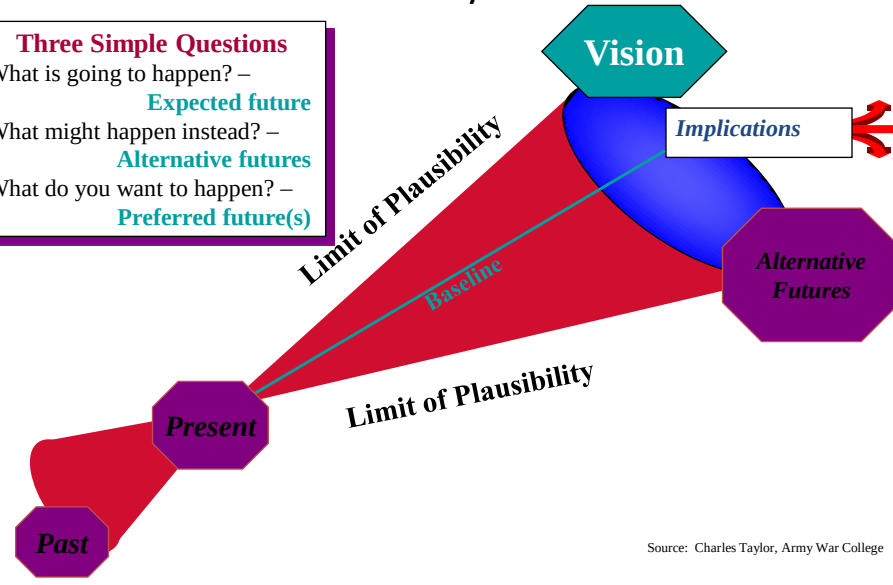

# The Cone of Plausibility

**Three Simple Questions**

What is going to happen? –
**Expected future**

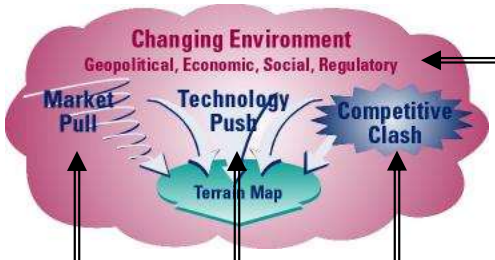
What might happen instead? –
**Alternative futures**

What do you want to happen? –
**Preferred future(s)**




Source: Charles Taylor, Army War College

# Terrain Map Overview



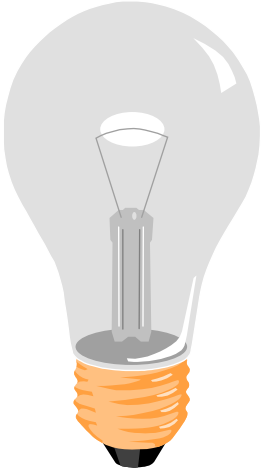

Country Profiles, Demographics, Regulatory Status, Domain Assets, World Issues

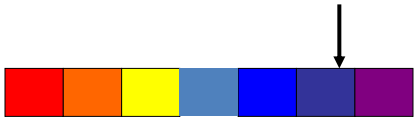
Historical Market Data, Market Research Studies

University Research, Federal Research Funding, Patents, Standards, Technology Relationships

Value Webs, Product Functionality Matrix







## Intuitor

- Future is complex
- Gather information
- Use experts
- Subconscious processing

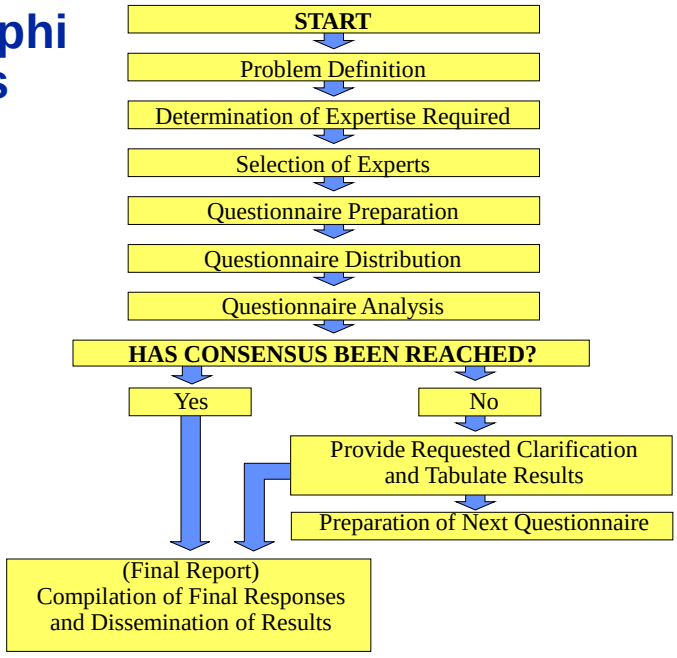
# Intuitor Techniques

- Delphi Surveys**
- Nominal Group Conferencing**
- Structured and Unstructured Interviews*
- Competitor Analysis*

** Quantitative

* Semi-Quantitative

# The Delphi Process

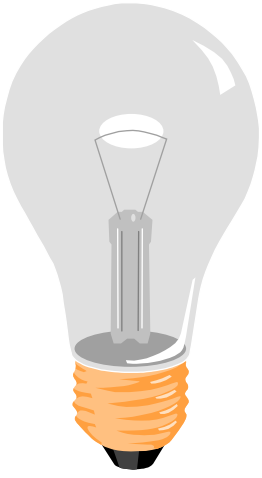


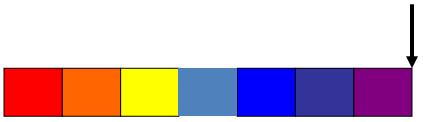
# Competitor Analysis

| | Current Market | Growth Rate | Key Sectors | Key Competitors | Strong Research Facilities |
|---|---|---|---|---|---|
| **Neuroscience** | $30B (US)<br>$52-59B (WW) | 16% | Alzheimer's Disease | CA, MA, NJ, NC, MD, PA, TX, GA | The Neurosciences Institute |
| **Cardiovascular** | Drugs:<br>$26B (US)<br>$84.9B (WW)<br>Devices:<br>$2.1B (US)<br>$12B (WW) | 14% | Blood Agents, Biomedical Engineering | MA, CA, NY, NC, OH, MN, GA, TX | Cardiovascular Research Foundation,<br>Mayo Clinic,<br>Cleveland Clinic |
| **Agri Biotech** | $2.0B (US)<br>Animal:<br>$1.9B (WW) | 15% | Transgenic Seeds | NC, MO, IA, TX, CA | The Danforth Center |
| **Cancer** | $15-18B (WW) | $11.5B US in 2006 | Innovative Therapeutics | CA, NY, PA, NC | National Cancer Institute |
| **Sports Centered Life Sciences** | Orthopedics:<br>$7.7B (US)<br>$13.1B (WW)<br>Sports Med:<br>$594M (US) | N/A* | Sports Related Sensors and Devices | MA, FL, MN, NC, IL, SC | The Brooks Institute for Sports,<br>The Gatorade Sports Science Institute |
| **Evidence Based Medicine** | N/A* | N/A* | Clinical Analysis, Data Exchange Tools, Information Resources | NC, PA | Blue Cross & Blue Shield Association, Duke University |
| **Proteomics/ Protein Analysis** | $963M (WW) | $5.6B WW in 2006 | Instruments, Wet Technologies & Supplies | CA, MA, NY, PA, TX, VA, NC, UT, MD | The Genomics Institute of Novartis Research Foundation |
| **Biosensors** | $282.8M (US)<br>$500M (WW) | $560M WW in 2002 | High-Throughput Screening | CA, NC, MI, OR, IA, TN, NY, NM, VA | Ames Laboratory, Center for Bioelectronics, Biosensors & Biochips |

# Characteristics of Intuitor Techniques

- Useful when situation is poorly defined
- Can identify changes in driving forces
- Can uncover more imaginative concepts
- Selecting and engaging experts is challenge
- **Problems when quantitative rigor is required**



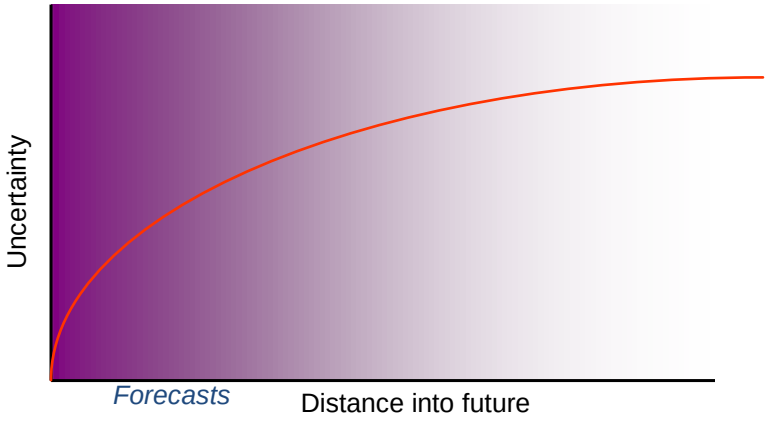


## Artist

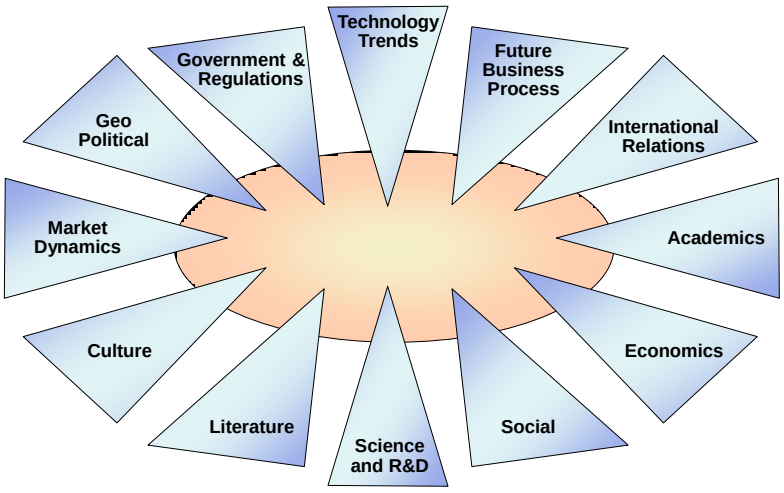
- There are no rules
- Out of the box
- Diverse Brainstorms
- Innovation drivers



# Dealing with Uncertainty



# Impacts



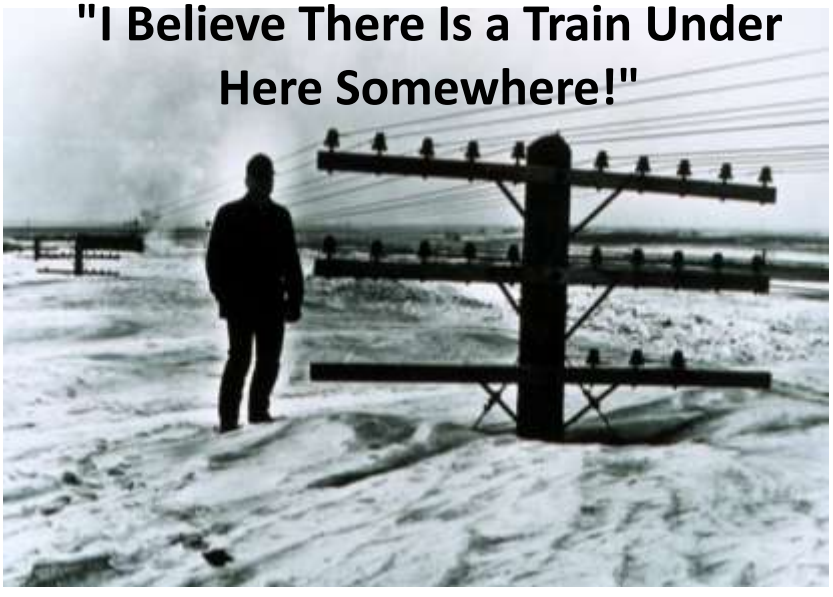



# Devil's Advocate

"Devil's Advocate" is a title given to one of the most important officers of the Catholic Church. Anytime there was a process for a new Pope or saint this position was to look at the negative side. This was a position until 1983. This reform changed the canonization process considerably, helping John Paul II to usher in an unprecedented number of elevations: nearly 500 individuals were canonized and over 1,300 were beatified during his tenure as Pope as compared to only 98 canonizations by all his predecessors.




## "I Believe There Is a Train Under Here Somewhere!"



http://www.photolib.noaa.gov/historic/nws/wea00958.htm

# THANKS

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