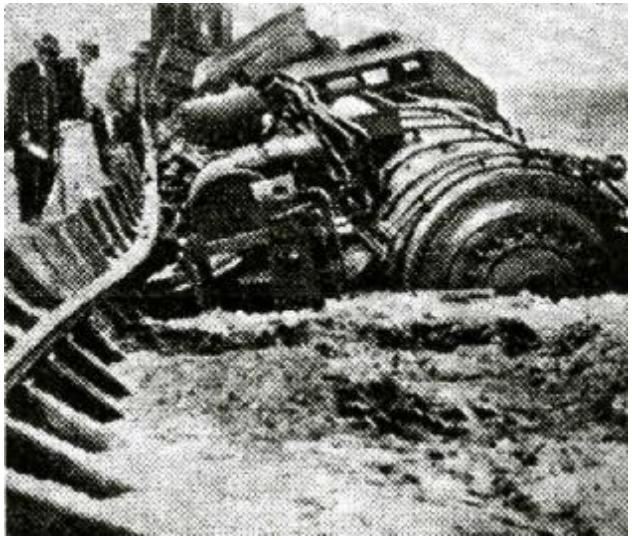
# CONVERTING FUNDAMENTAL KNOWLEDGE TO INFRASTRUCTURE RELIABILITY



THURSDAY, APRIL 24, 2008

Dr. Clem Hiel
President
Composite Support & Solutions Inc

Critical National Needs in New Technologies:
Opportunities for the TIP

# PRESENTATION LAYOUT

1. INTRODUCTION: Scale of the problems..
2. INFRASTRUCTURE RELIABILITY: A Short Case Study
3. MOTIVATION FOR HIGH RISK/ HIGH REWARD TECHNOLOGY DEVELOPMENT
4. CONCLUSIONS

# INTRODUCTION: The Scale of these Problems Requires **NEW THINKING**

## 2005 Report Card for America's Infrastructure

| | |
|---|---|
| Aviation | D+ |
| Bridges | C |
| Dams | D |
| Drinking Water | D- |
| Energy | D |
| Hazardous Waste | D |
| Navigable Waterways | D- |
| Public Parks & Recreation | C- |
| Rail | C- |
| Roads | D |
| Schools | D |
| Security | I |
| Solid Waste | C+ |
| Transit | D+ |
| Wastewater | D- |

America's Infrastructure G.P.A.= D

Total Investment Needs = $1.6 Trillion
(estimated 5 year need)

# INFRASTRUCTURE INNOVATION WITH HIGH RISK/ HIGH PAYOFF/ HIGH SOCIETAL VALUE

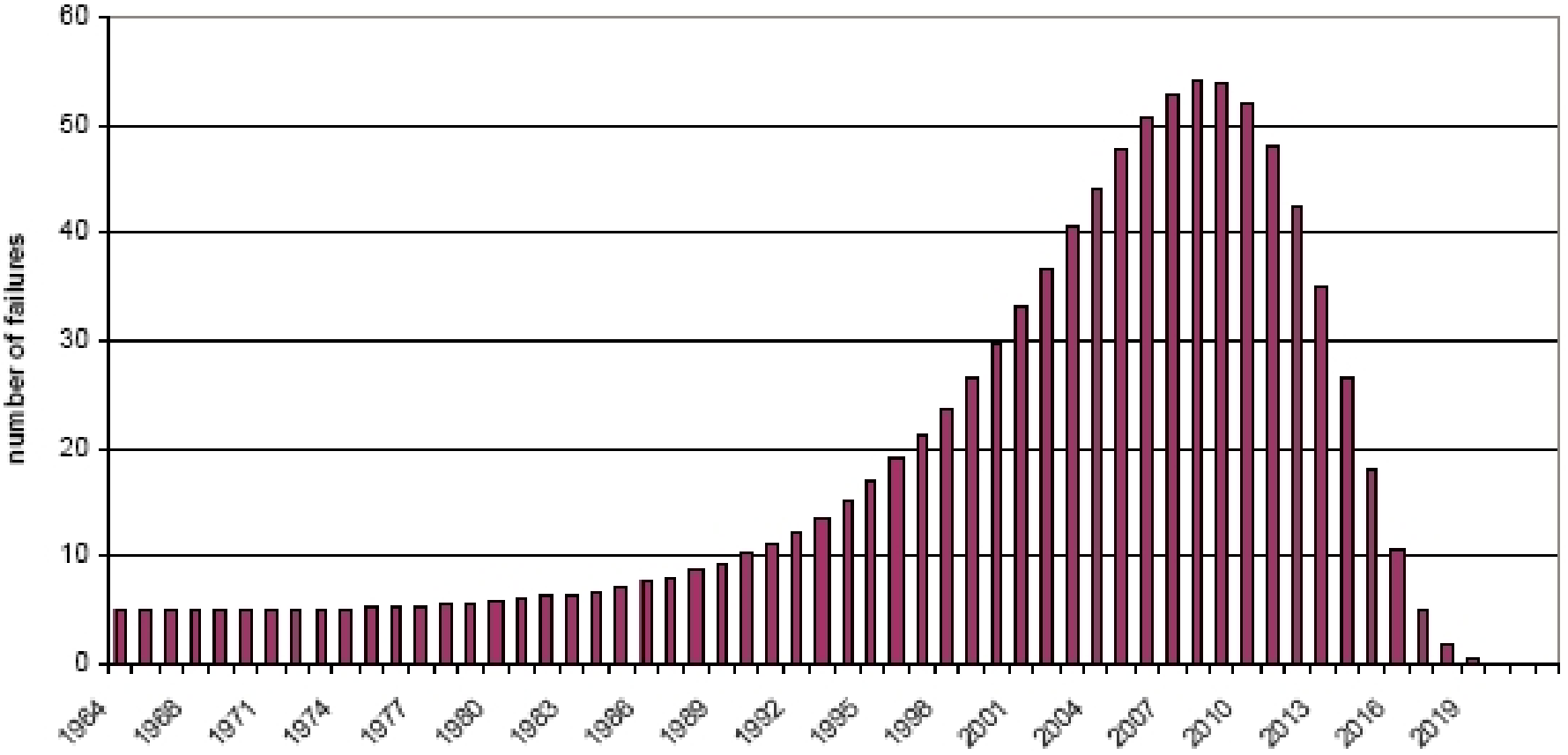
| | **MITIGATION REHABILITATION RETROFIT** | **NEW CONSTRUCTION SUSTAINABLE INFRASTRUCTURE** | **INFRASTRUCTURE SECURITY** |
|---|---|---|---|
| **NEW MATERIALS**<br>**Composites**<br>**Concrete**<br>**Hybrids**<br>**Nano-materials**<br>**Modeling** | Seismic Retrofit<br>Corrosion ($ 300 B/yr)<br>Fire Resistant<br>Fast in & Out (2.3 B Gal due to idling…/Delay 15->47 hours) | Extreme weather<br>Fire resistant<br>Affordability<br>Self cleaning…<br>Low energy content | Fire resistant<br>Blast Resistant |
| **STRUCTURAL HEALTH**<br>**Assessment**<br>**NDT/ NDE**<br>**Modeling** | Rapid inspection T<br>Embedded sensors (wired and wireless) | Self diagnosing<br>Self repair<br>Data mining<br>Smart interfaces | Embedded sensors<br>Data mining<br>Smart interfaces |

# 2. INFRASTRUCTURE RELIABILITY

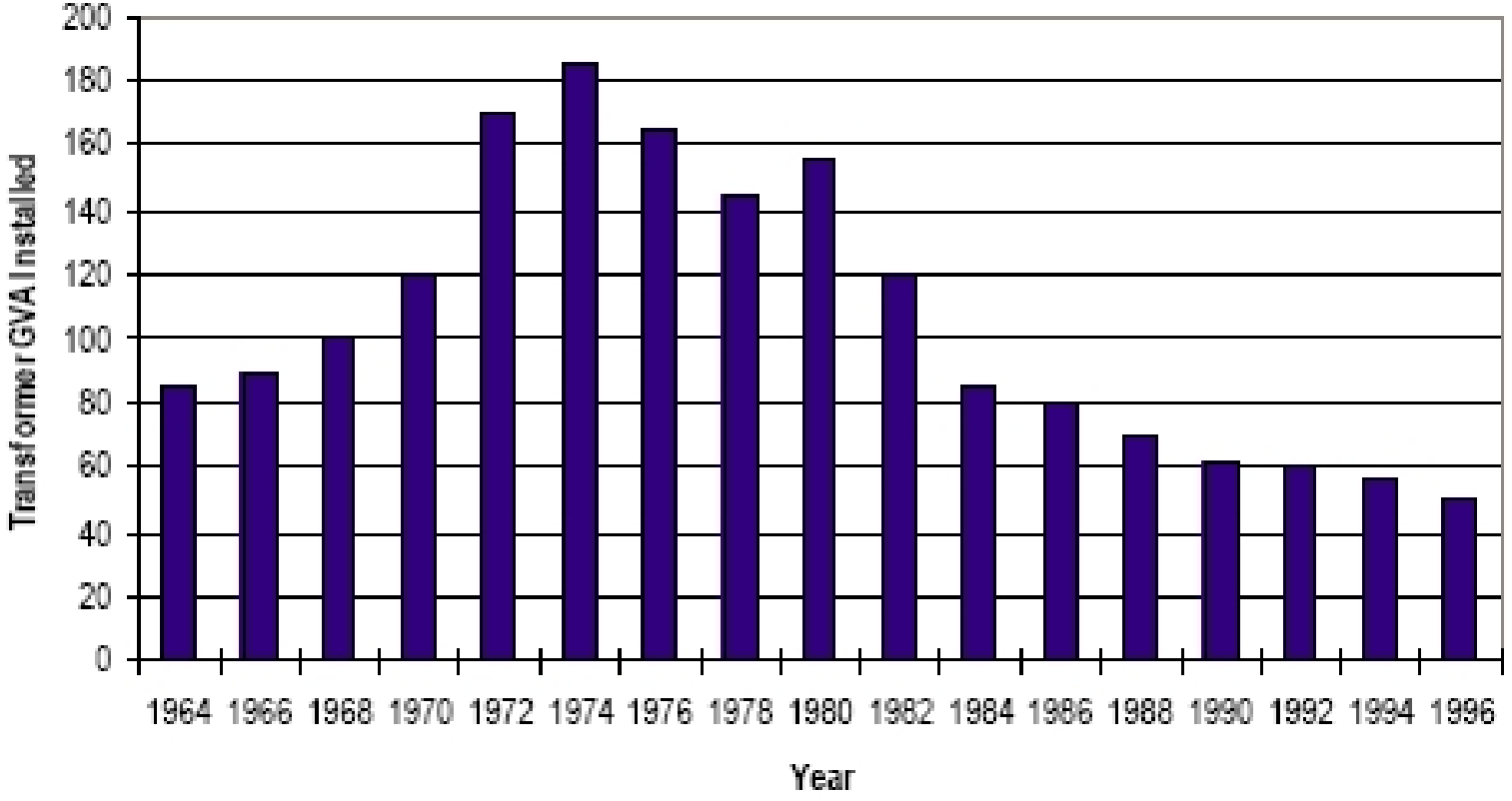
## A SHORT CASE STUDY


4 7:33PM

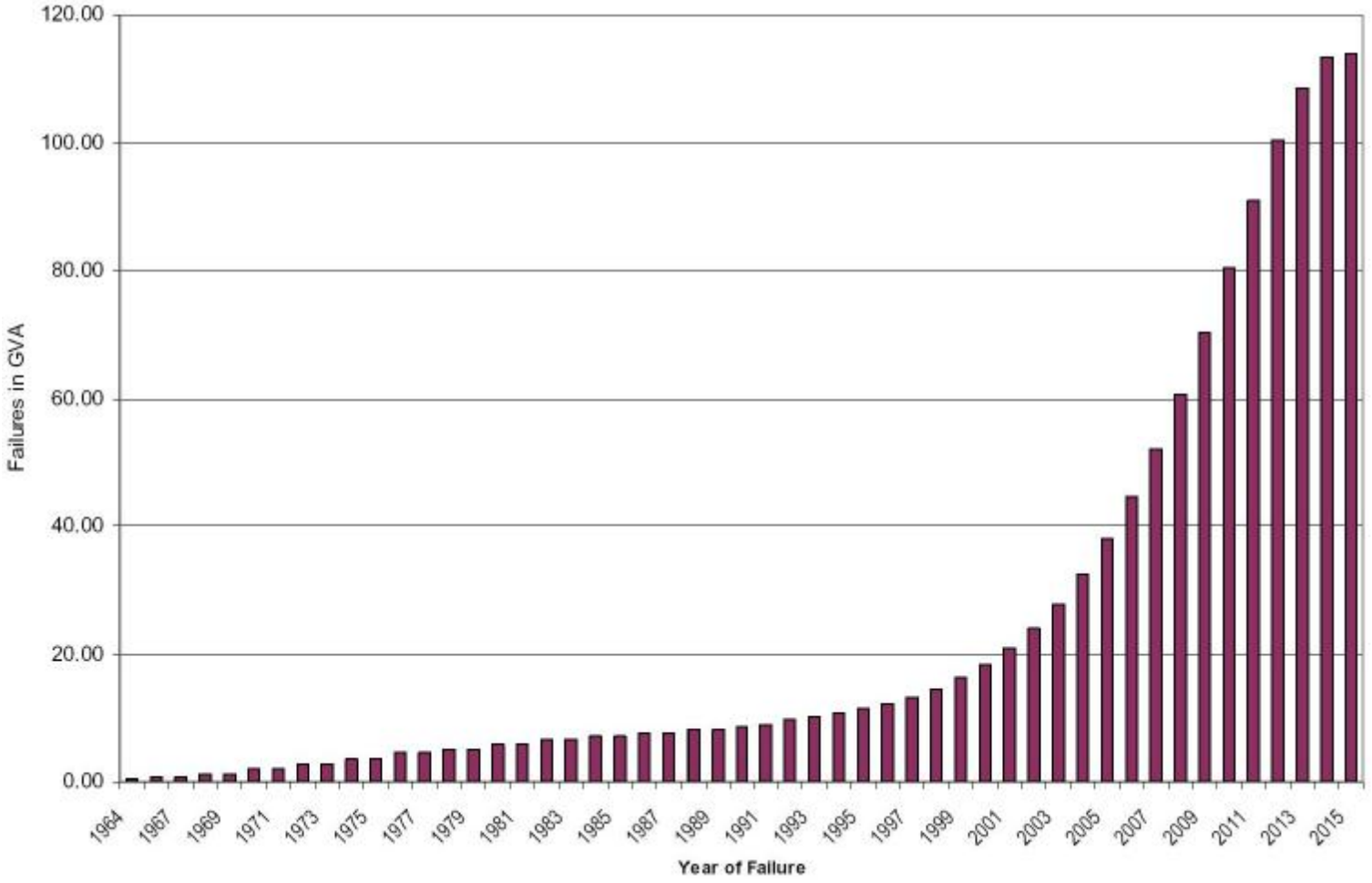
# PREDICTED FAILURE RATE FOR 1964 TRANSFORMERS (1000 UNITS)



# INSTALLED TRANSFORMER CAPACITY



# Predicted Failure Distribution




Source: Hartford Steam Boiler Insurance Company

# Societal Issues

- Electricity demand has doubled over the past 30 years!

| | Voltage Range (KV) | Power Range (MVA) | NUMBER | AVERAGE AGE |
|---|---|---|---|---|
| Large | 115-765 | 1,000-1,200 | 5000 | 40+ |
| Medium | 65-345 | 10-100 | 110,000 | 35+ |
| Small | 32-245 | 1-10 | 65,000 | 25+ |

- 2 year lead time for new power transformers

# INFRASTRUCTURE INNOVATION WITH HIGH RISK/ HIGH PAYOFF/ HIGH SOCIETAL VALUE

| | **MITIGATION**<br>**REHABILITATION**<br>**RETROFIT** | **NEW CONSTRUCTION**<br>**SUSTAINABLE INFRASTRUCTURE** | **INFRASTRUCTURE SECURITY** |
|---|---|---|---|
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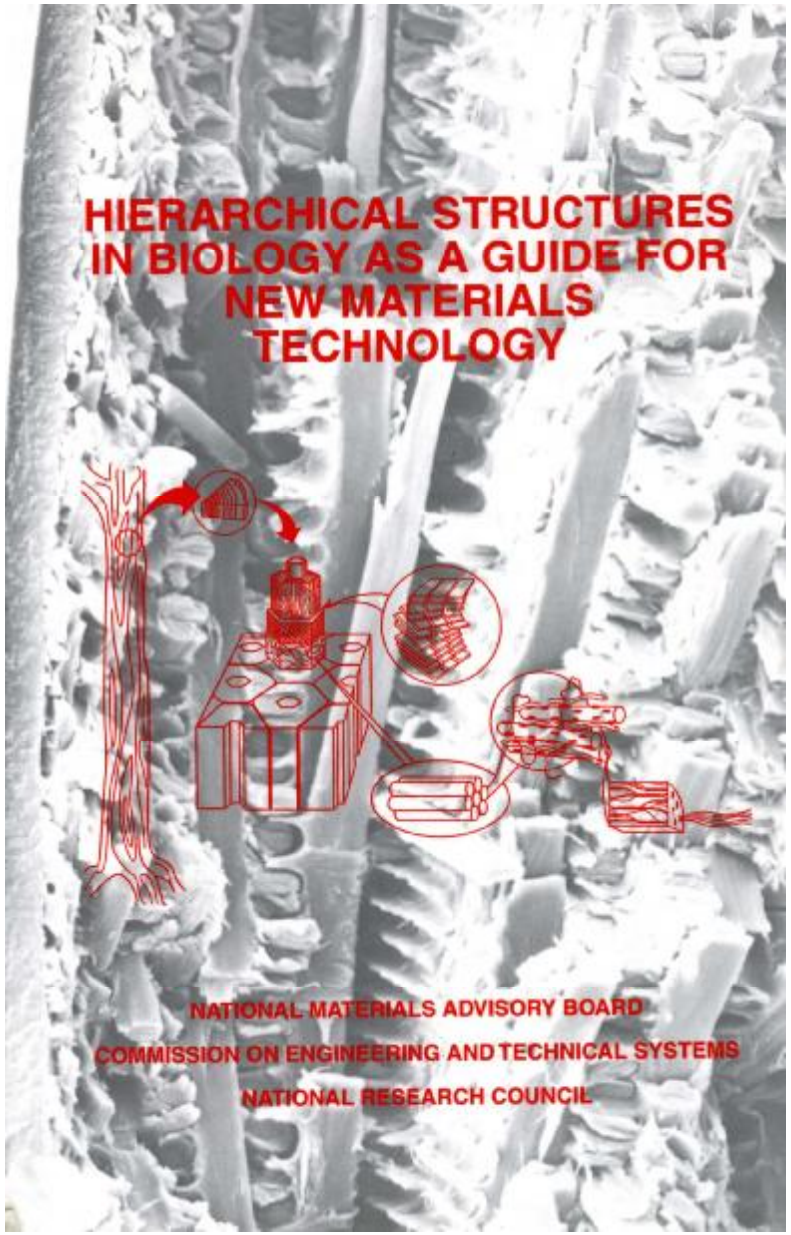
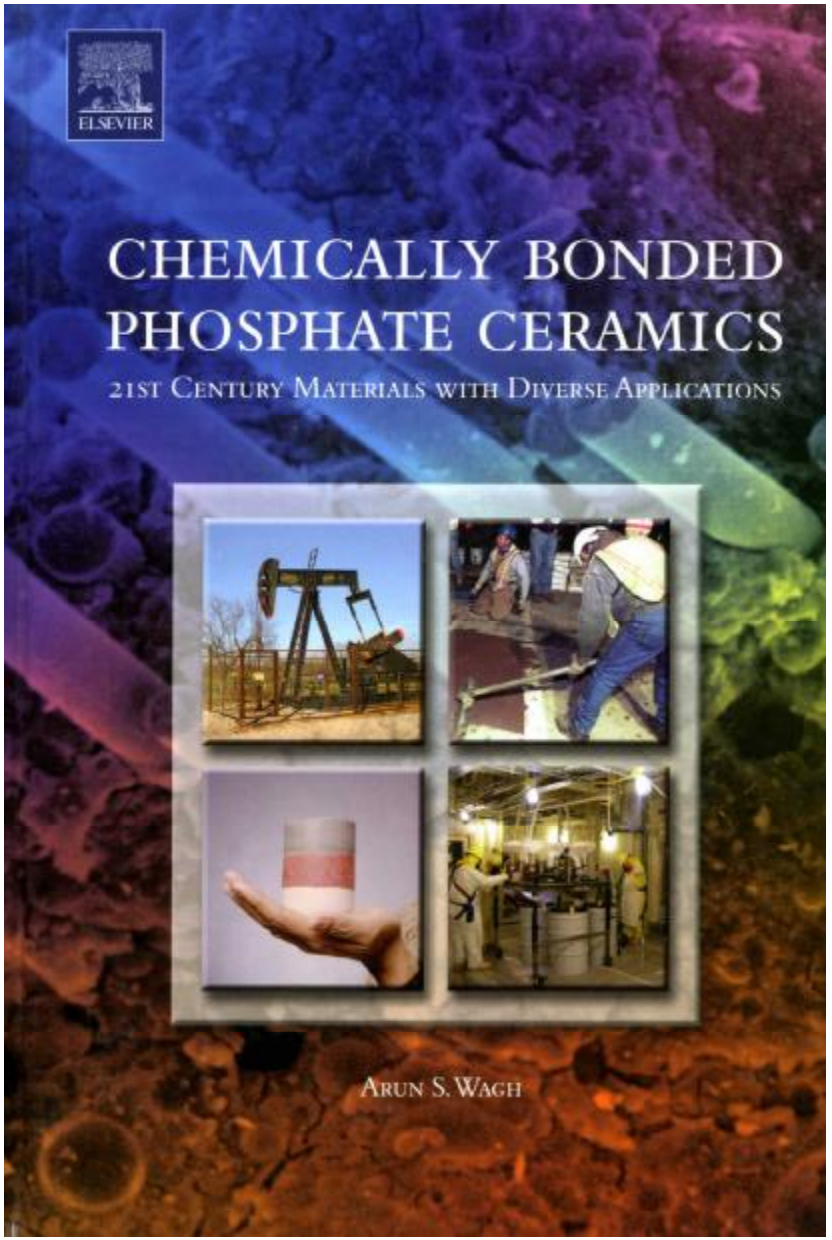
# NEW MATERIALS




MITIGATION
Fast in & Out
S-60


1 DAY INSTALLATION



# ASCE(*) 2008
# CHARLES PANKOW AWARD
# FOR INNOVATION

(*)ASCE: American Society for Civil Engineers

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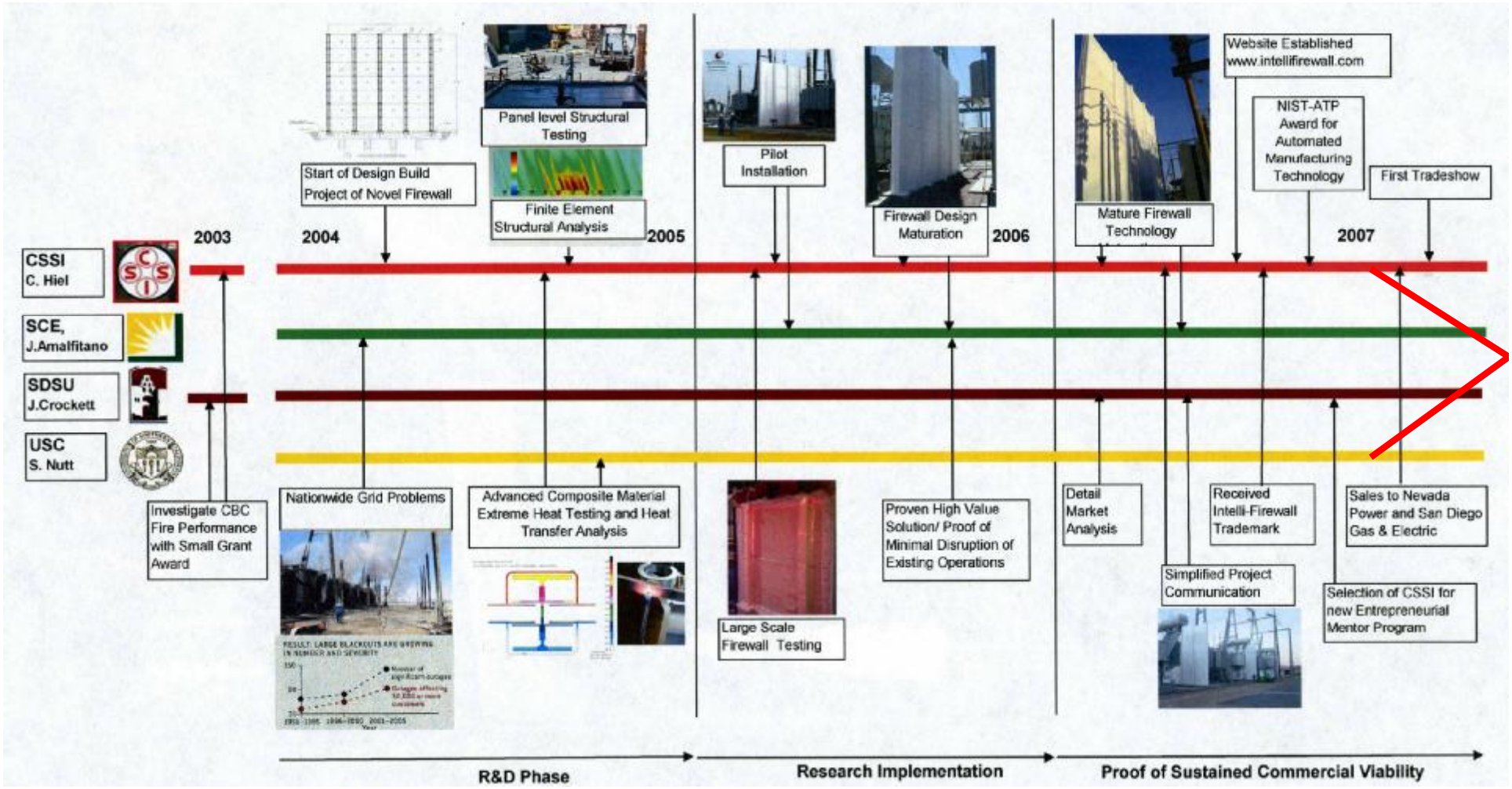
# TECHNOLOGY ALONE IS NOT ENOUGH…

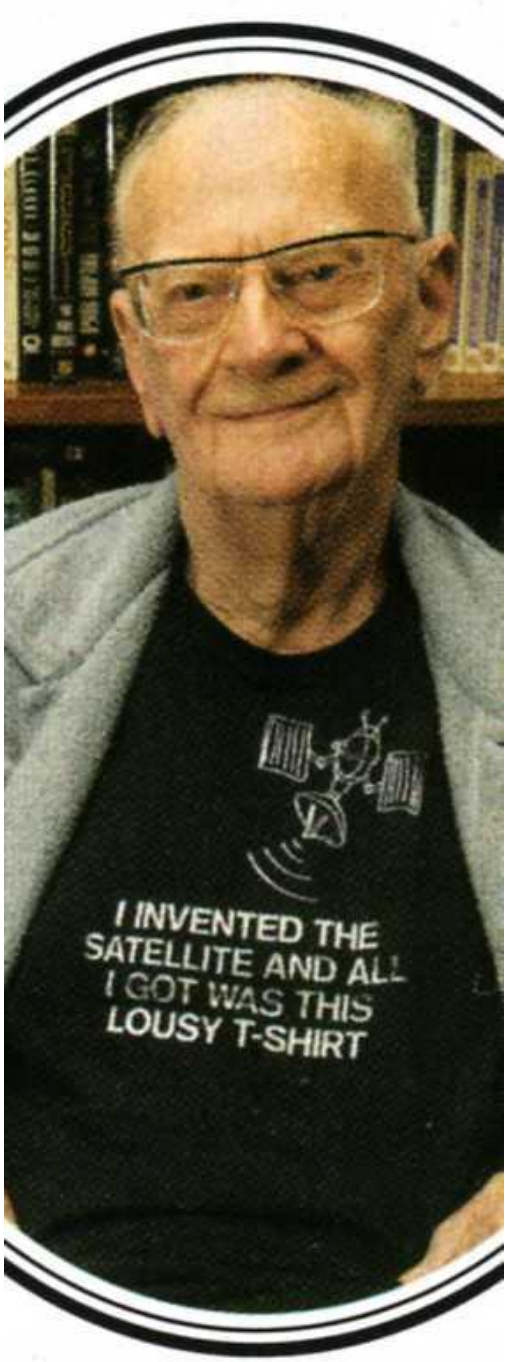
- DEPLOYMENT IS INVARIABLY THE RESULT OF THE DEDICATION OF A CHAMPION INSIDE THE CUSTOMERS ORGANIZATION TO SEE IT THROUGH

# BUILDING THE INNOVATION PIPELINE



# 3. MOTIVATION FOR HIGH RISK HIGH REWARD TECHNOLOGY DEVELOPMENT THAT PUSHES THE SCIENTIFIC FRONTIERS

# INVENTION ALONE IS NOT ENOUGH

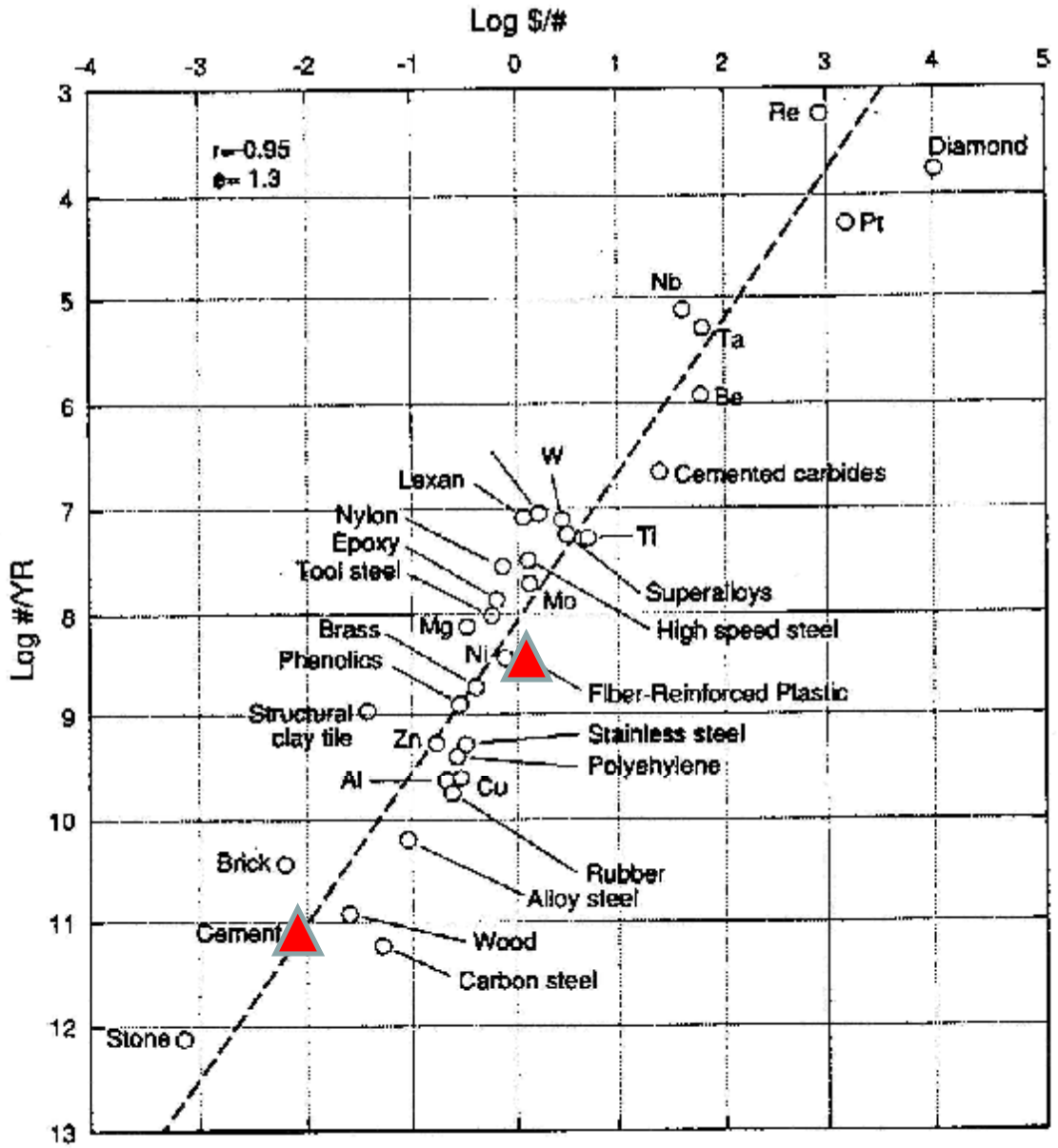



Arthur C. Clarke:

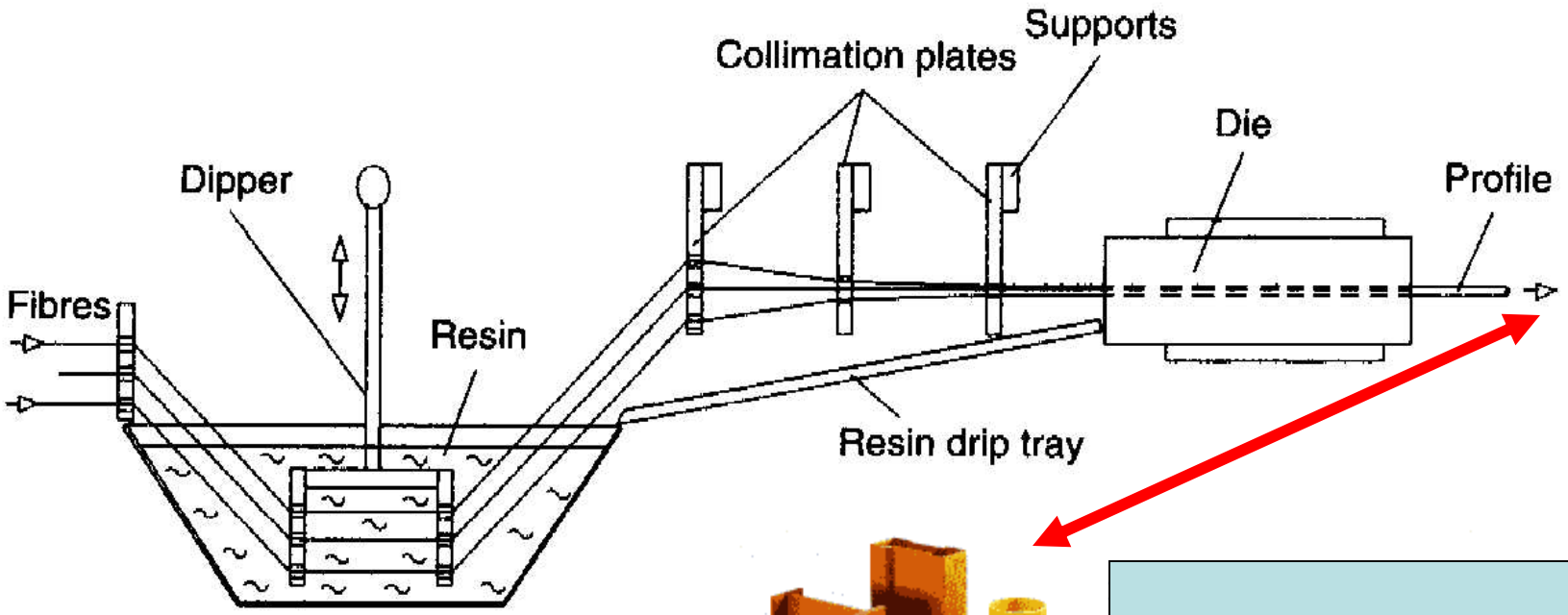
"I invented the Satellite
and
all I got was
This lousy T-shirt."

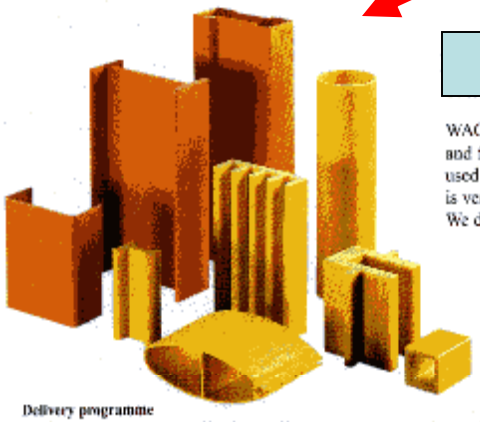
**(*) Wireless World, October, 1945**

# DEMAND CHART: PRICE VERSUS CONSUMPTION (*)



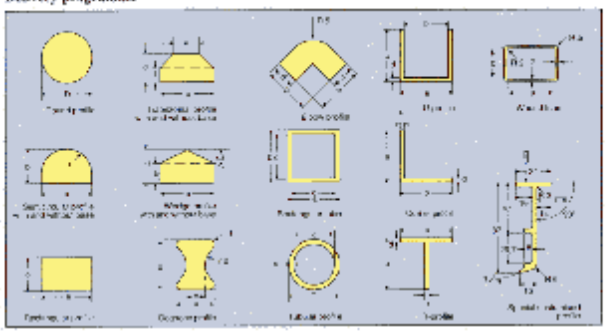

(*) Dr. John Gillman (Courtesy J.H. Westbrook)



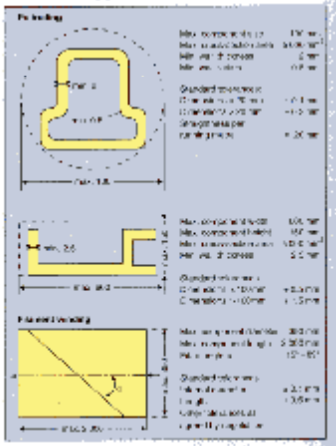



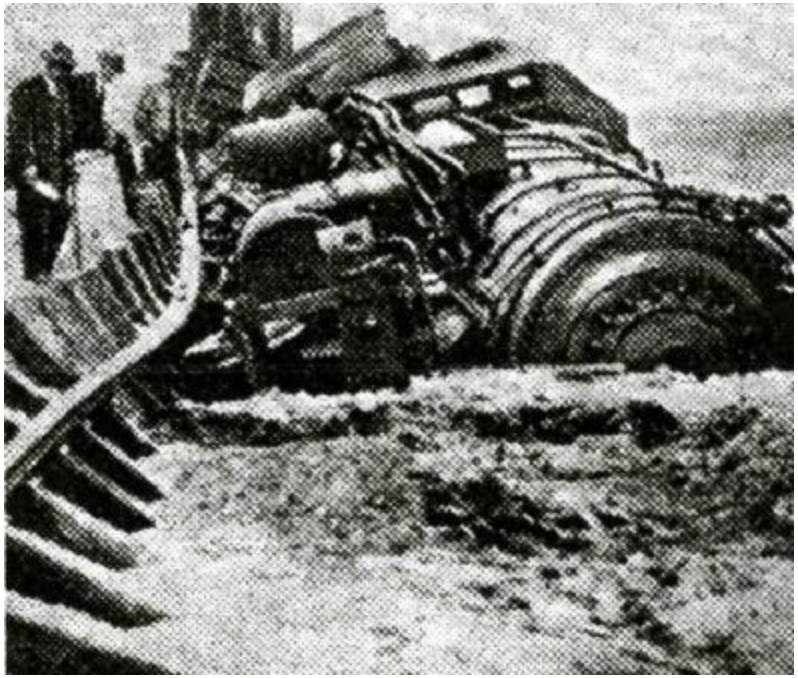
WACOSIT® plastic profiles are pultruded from resin-impregnated rovings and fabric tapes. Besides glass fibres, carbon fibres and aramide fibres are used as the material to strengthen the structure. The range of types available is very large and there are now more than 3,000 standard tools to choose from. We do of course fabricate customised profiles of special design as well.

Delivery programme



Manufacturing possibilities






American Scientist
JULY–AUGUST 1997
THE MAGAZINE OF SIGMA XI, THE SCIENTIFIC RESEARCH SOCIETY
GAP:
HOW TO DESIGN WITH NEW MATERIALS ?
...a materials database is not enough!!!

# 4. CONCLUSIONS

- THE SCALE OF OUR KNOWN INFRASTRUCTURE PROBLEMS REQUIRES NEW THINKING
- REVOLUTIONARY IMPROVEMENTS ARE NEEDED IN STRUCTURAL PERFORMANCE, MONITORING, SENSING, MITIGATION,…
- TECHNOLOGY ALONE IS NOT ENOUGH….
- IT TAKES DEDICATED PARTNERSHIPS TO BUILD THE INNOVATION PIPELINE
- INVENTION ALONE IS NOT ENOUGH…