KEY INGREDIENTS FOR SUCCESSFUL IMPLEMENTATION OF PAVEMENT MANAGEMENT SYSTEMS

2002 Southeastern Pavement Management and Design Conference

Nashville, June 23-26, 2002

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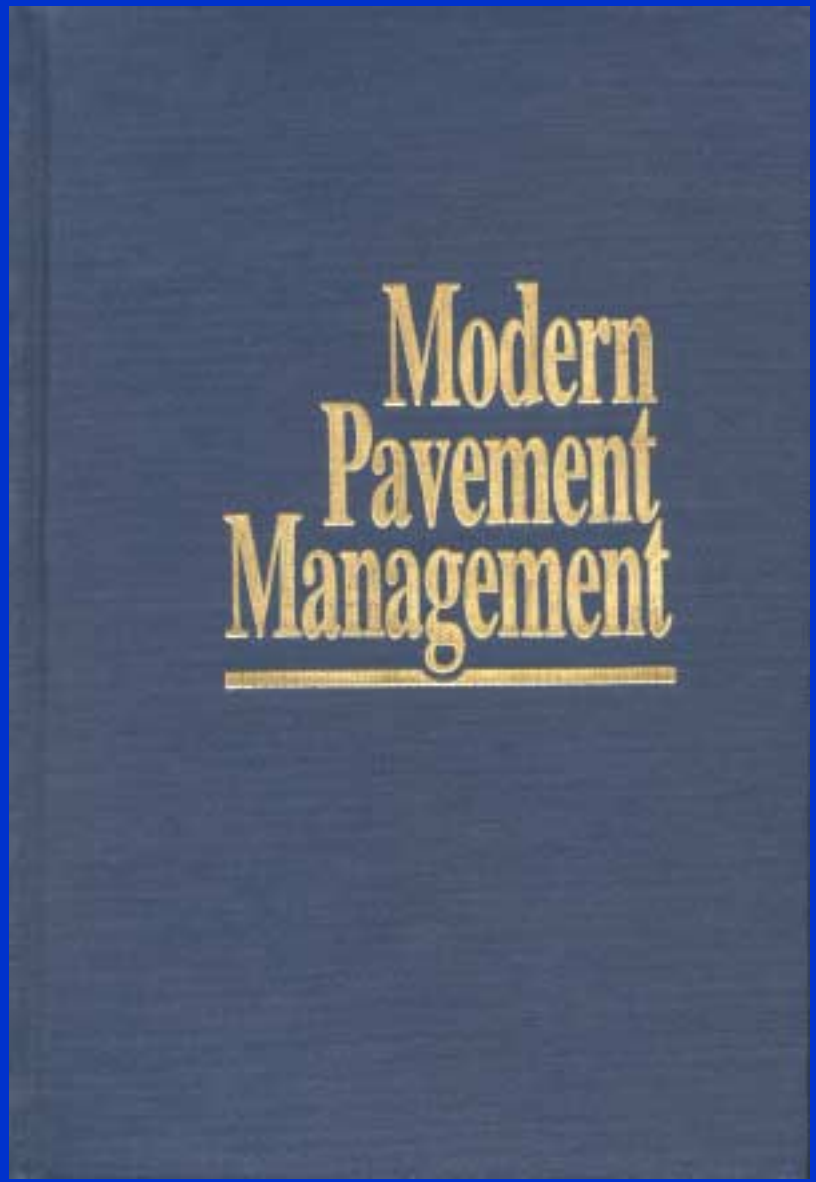
University of Waterloo
Canada



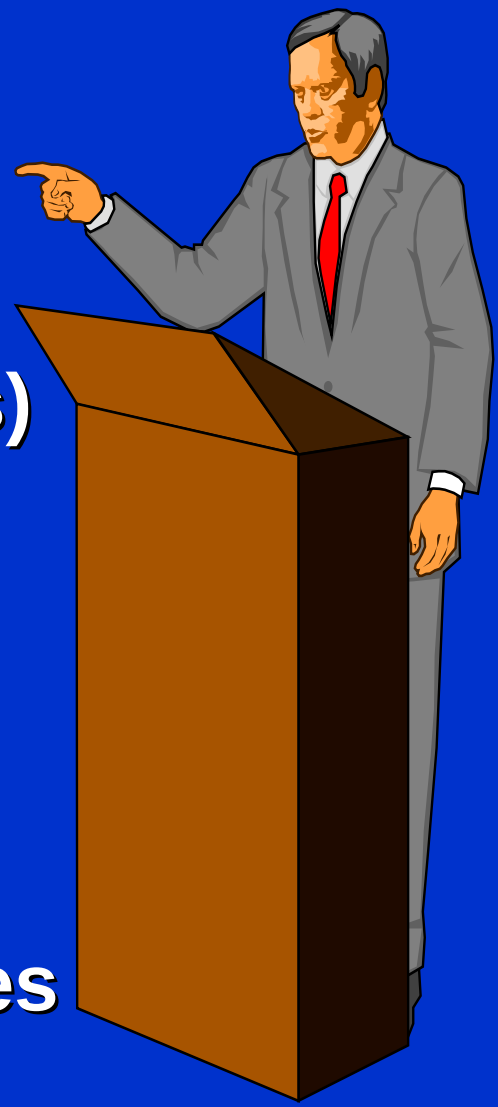
IMPLEMENTATION SUCCESS ?

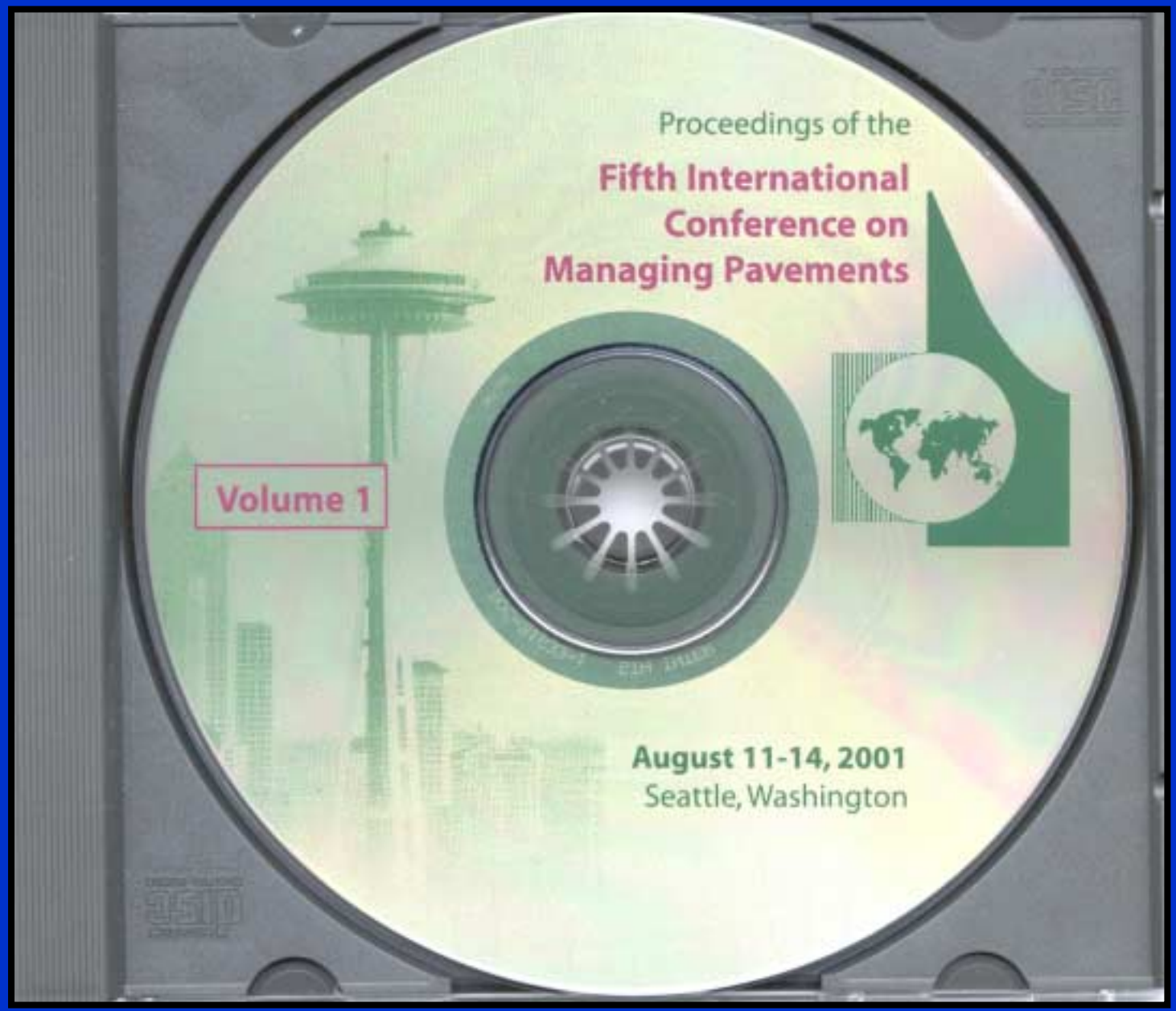
They Vary Because of

- Commitment
- Understanding the Technology
- Serving Users
- Application Levels
- Resources
- Succession Planning

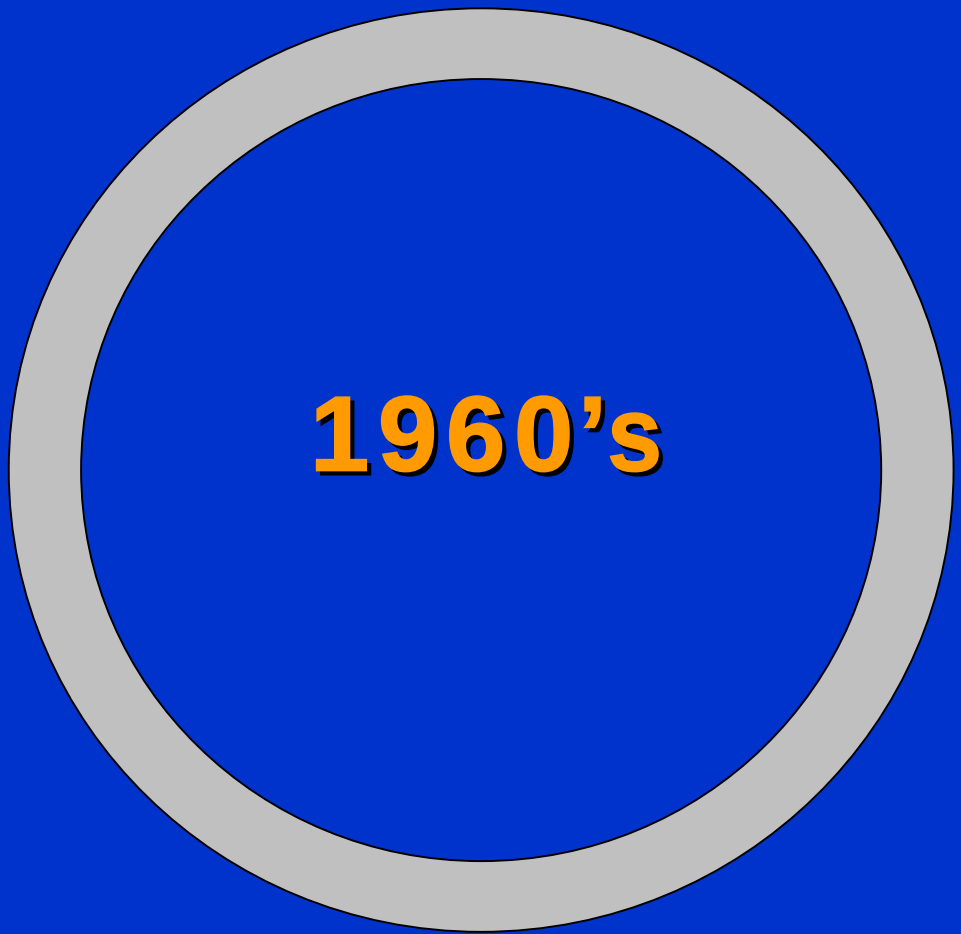
PRESENTATION

- A brief look back
- Successes / strengths (key ingredients; technical underpinnings)
- Facing the key issues in implementation
- Major needs in P.M. practice
- Future expectations and opportunities



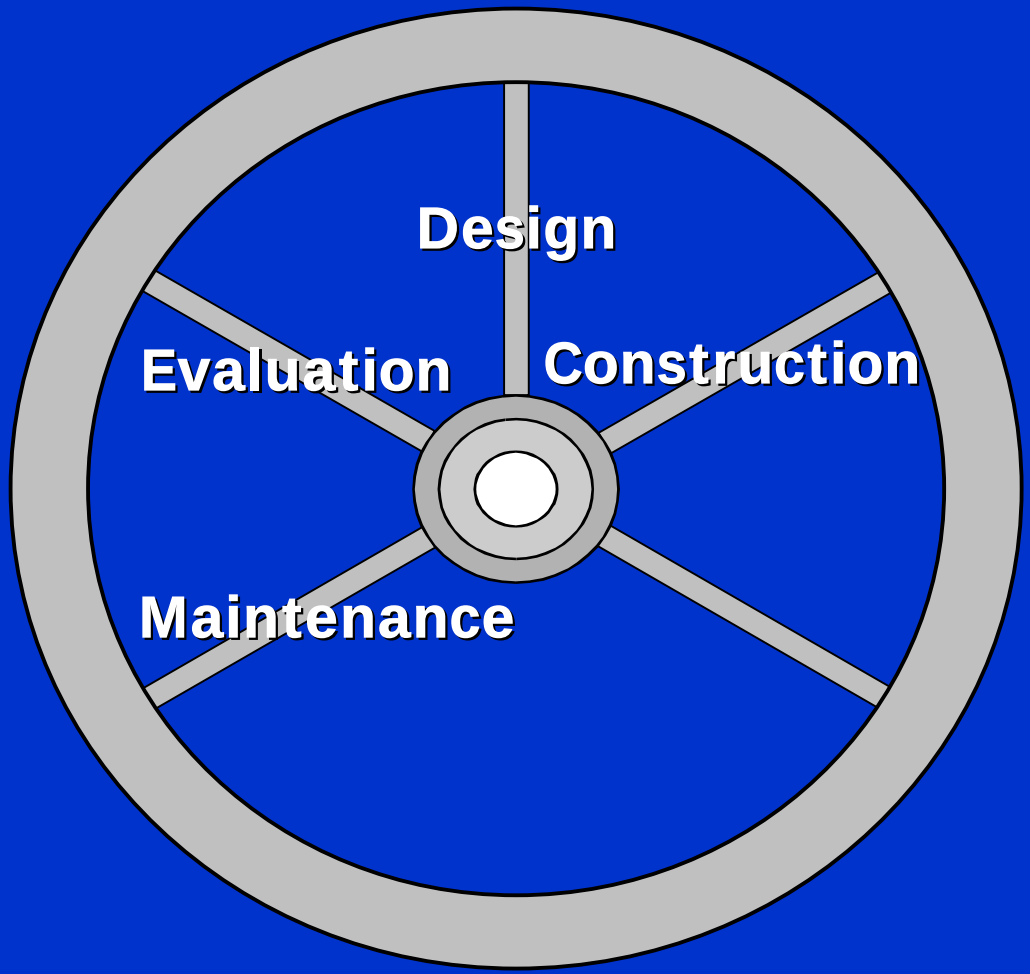

Proceedings of the
Fifth International
Conference on
Managing Pavements
Volume 1
August 11-14, 2001
Seattle, Washington

To Begin !



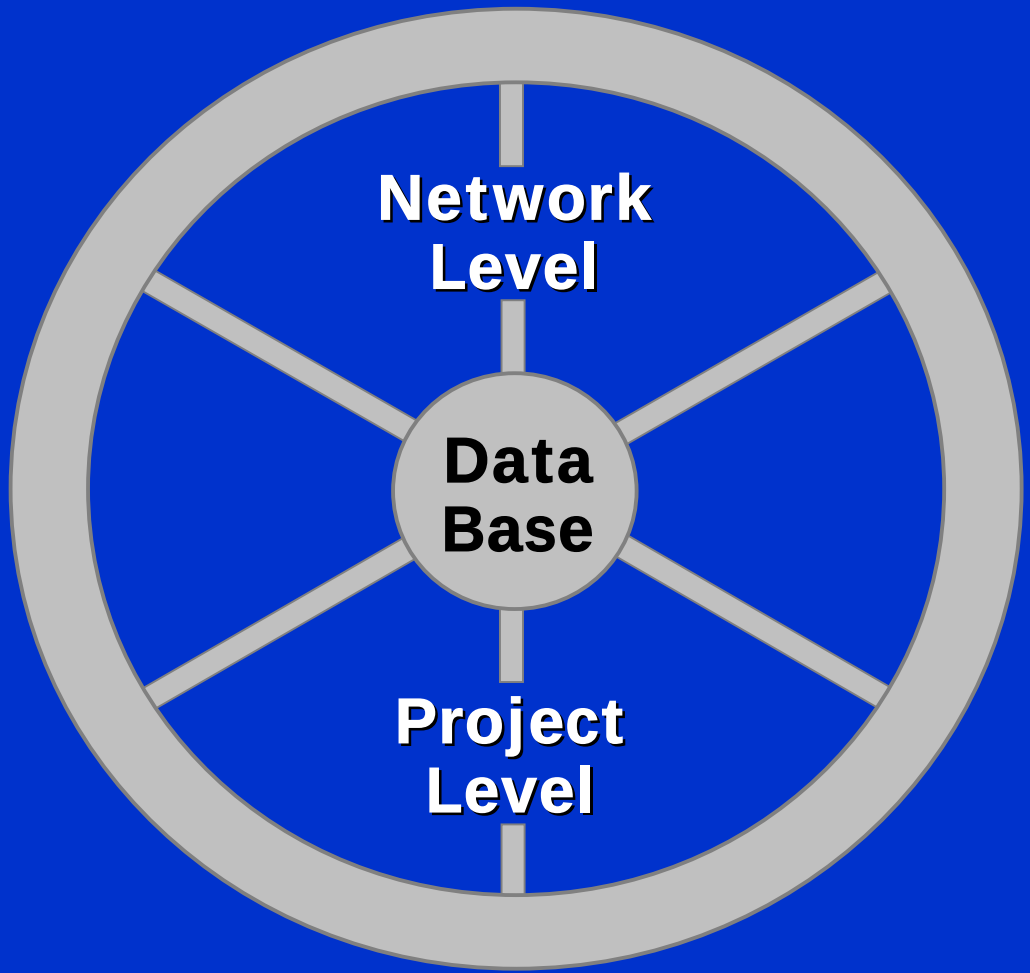
Pavement Management Concept

Early Days !



Pavement Management Framework

Maturity



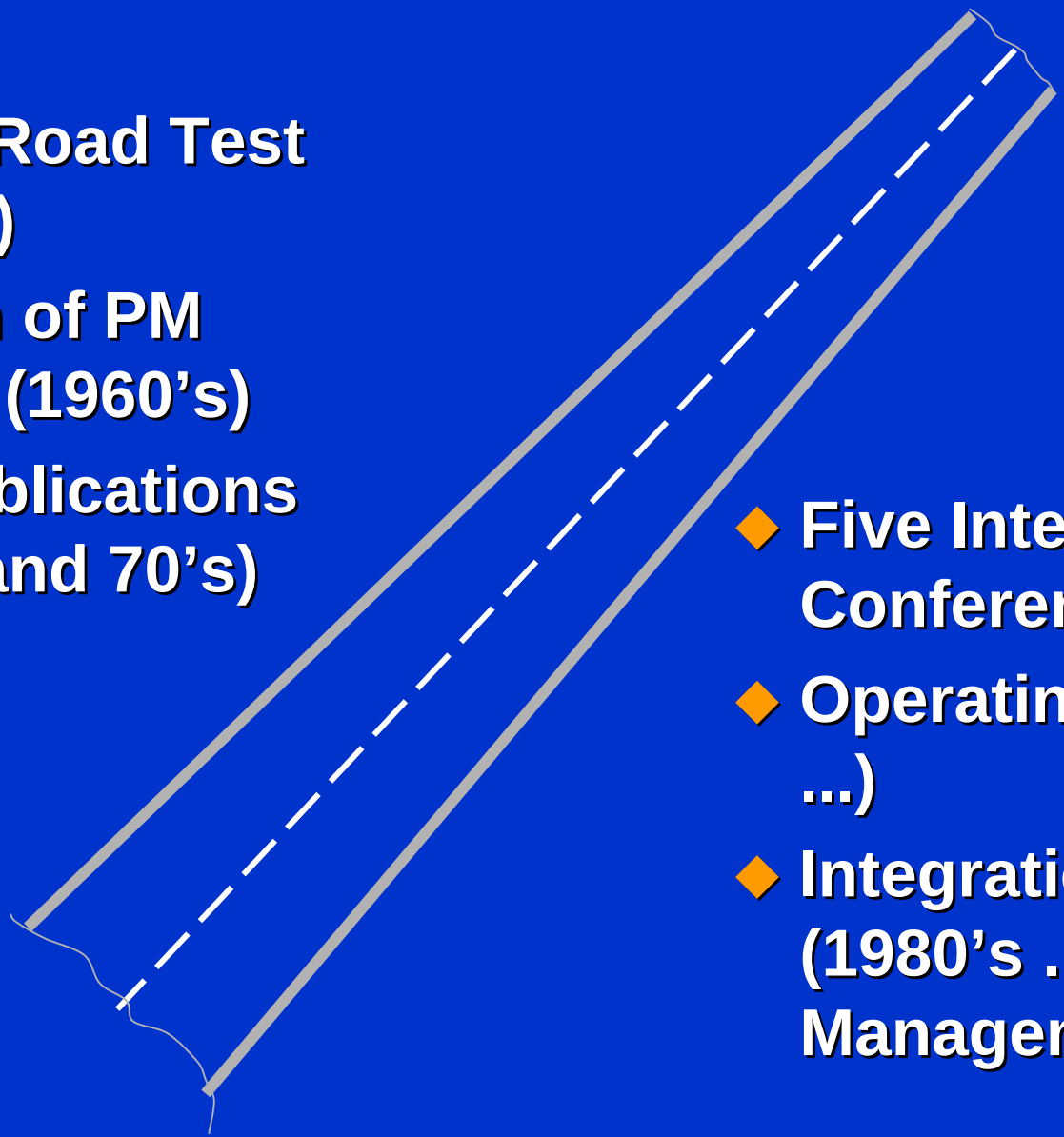
Operating Pavement Management Systems

Today

Tomorrow ?

Evolution in the Modern Era

- AASHO Road Test (1958-61)
- Initiation of PM Process (1960's)
- Early publications (1960's and 70's)



- Five International Conferences (1985-2001)
- Operating PMS's (1970's ...)
- Integration with BMS, etc. (1980's ...) and then Asset Management (1990's ...)

Successes and Current Status of Pavement Management

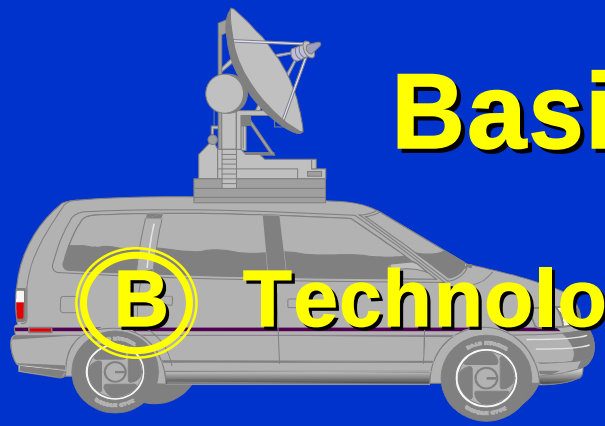
(What Doesn't Need to be Reinvented !)

- Basic lessons learned
- Comprehensive, generic framework - project and network levels
- Widespread implementation
- Key component technologies

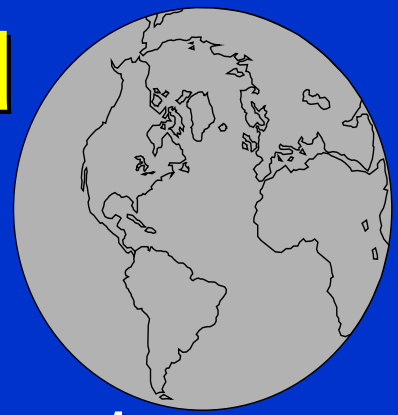
Basic Lessons Learned

Ⓐ Pavement Management Framework

- Generic framework characterizes process
- Flexibility exists for different models, methods and procedures
- Two basic operation levels are network and project

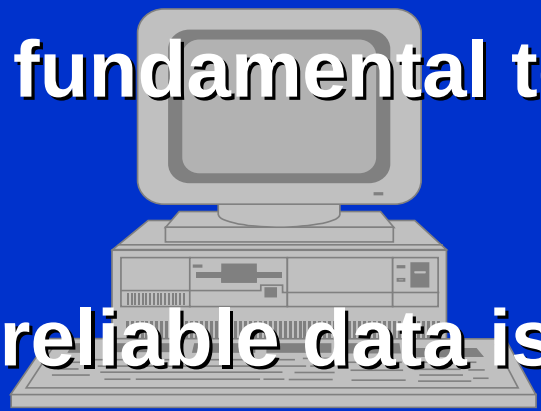


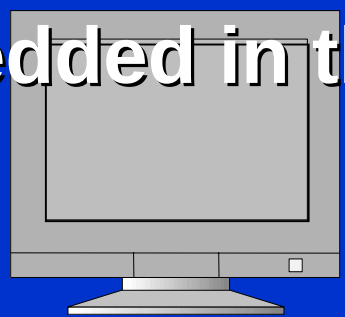
Basic Lessons Learned

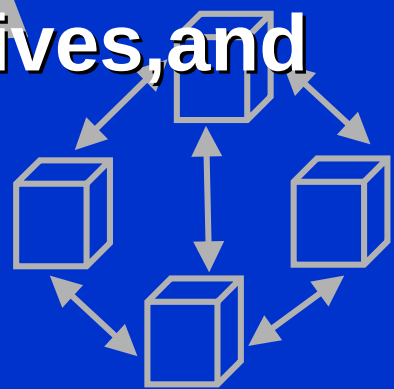


B Technological Base

- Sound base is fundamental to Pavement Management
- Sufficient and reliable data is essential
- Need capability to evaluate alternatives,and have LCCA embedded in the PMS



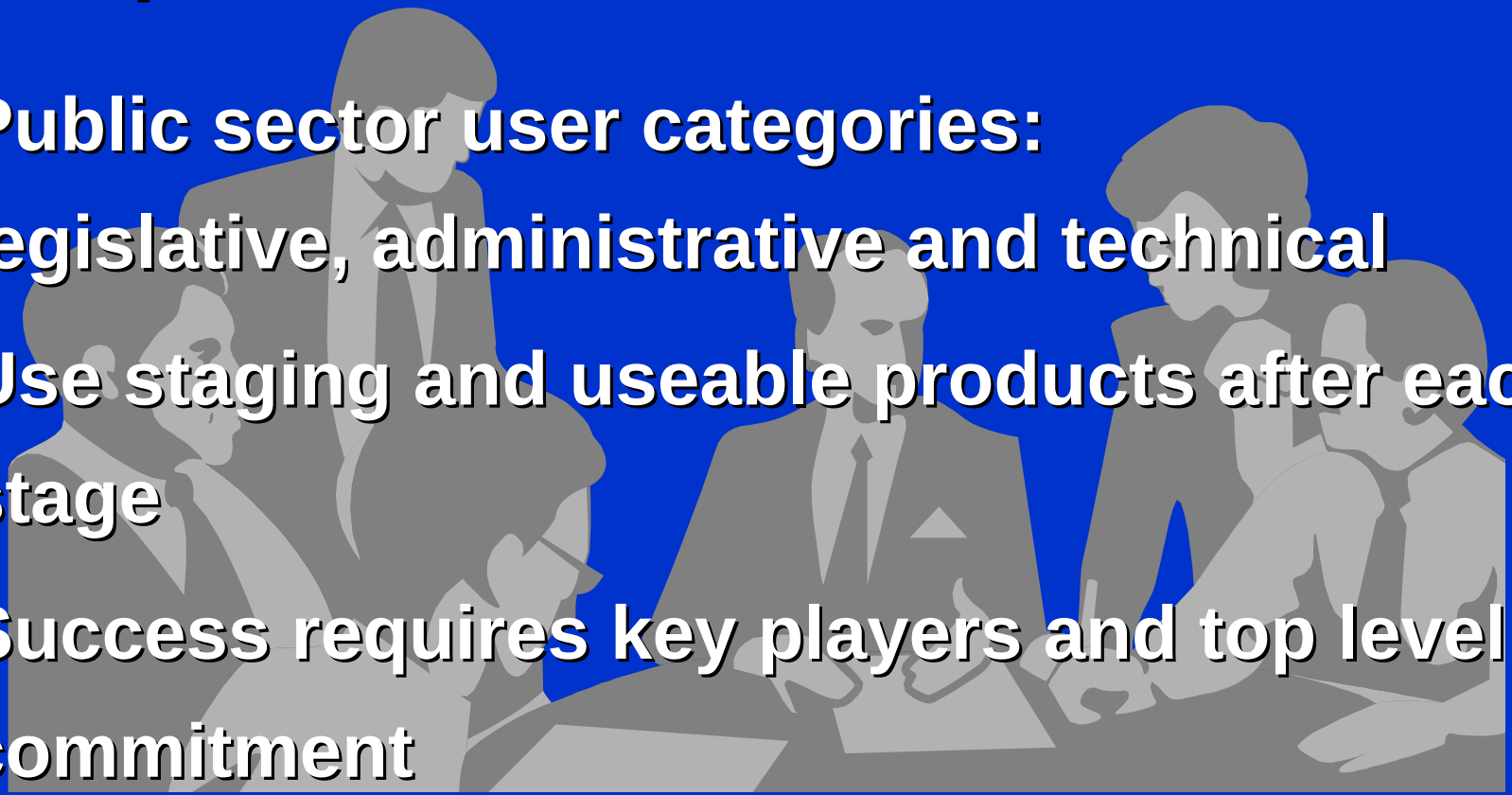


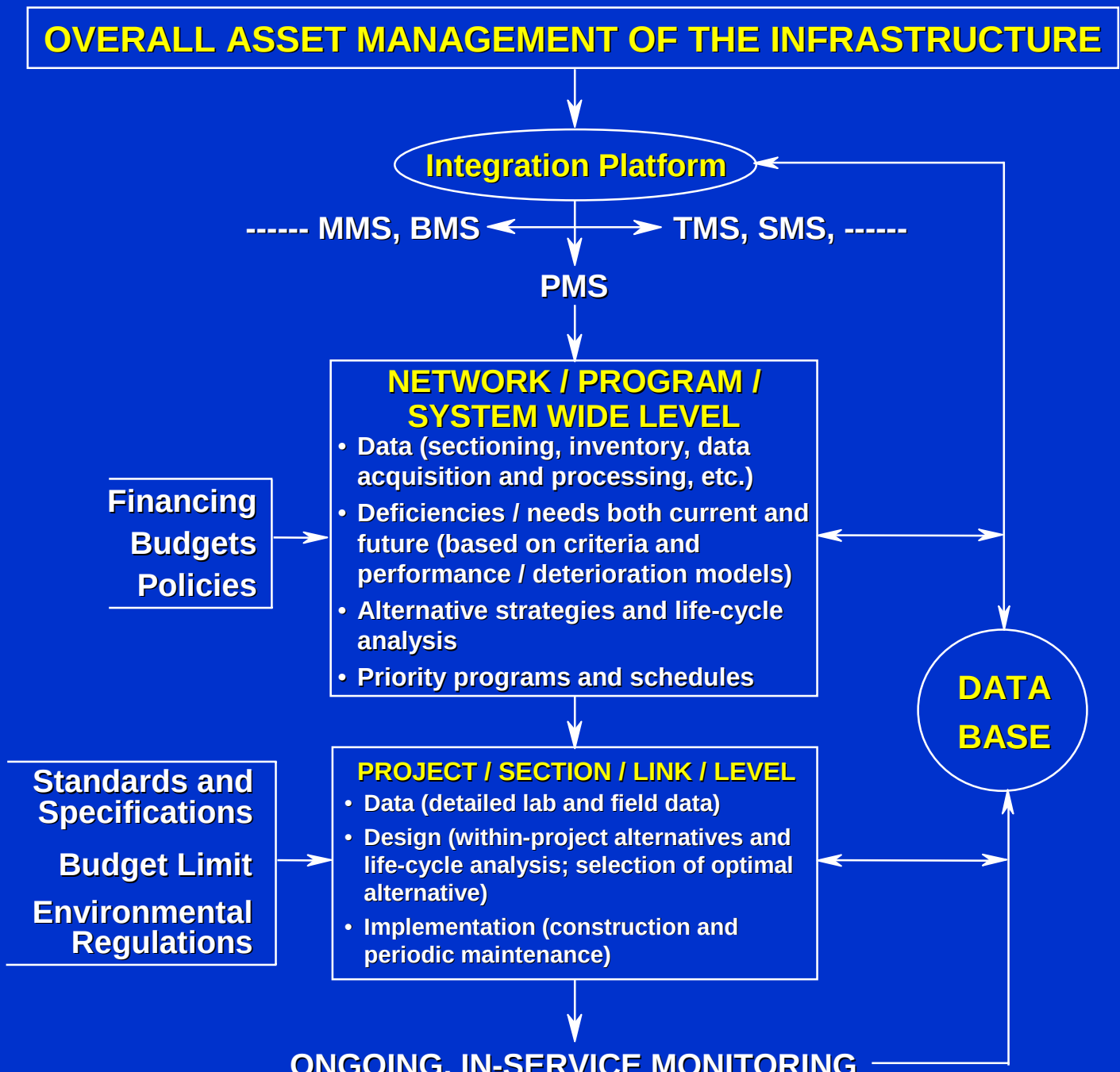


Basic Lessons Learned

© Implementation

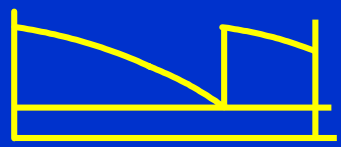
- Public sector user categories: legislative, administrative and technical
- Use staging and useable products after each stage
- Success requires key players and top level commitment

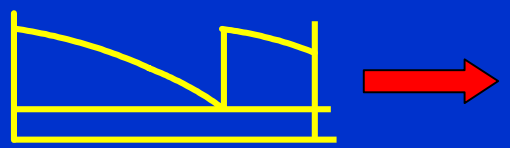



OVERALL ASSET MANAGEMENT OF THE INFRASTRUCTURE
Integration Platform
------ MMS, BMS
TMS, SMS, ------
PMS
NETWORK / PROGRAM / SYSTEM WIDE LEVEL
• Data (sectioning, inventory, data acquisition and processing, etc.)
• Deficiencies / needs both current and future (based on criteria and performance / deterioration models)
• Alternative strategies and life-cycle analysis
• Priority programs and schedules
Financing
Budgets
Policies
DATA BASE
Standards and Specifications
Budget Limit
Environmental Regulations
PROJECT / SECTION / LINK / LEVEL
• Data (detailed lab and field data)
• Design (within-project alternatives and life-cycle analysis; selection of optimal alternative)
• Implementation (construction and periodic maintenance)
ONGOING, IN-SERVICE MONITORING

TECHNOLOGY HIGHLIGHTS

- Automated surveillance
- Performance models
- Life cycle analysis
- User cost models
- Prioritization methods



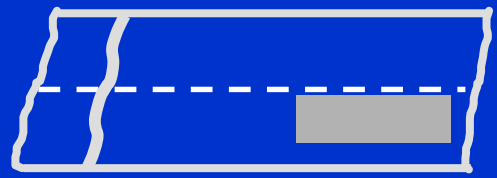


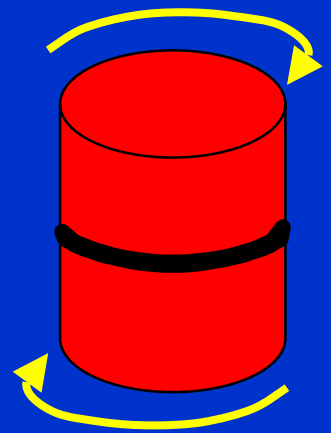
$ $

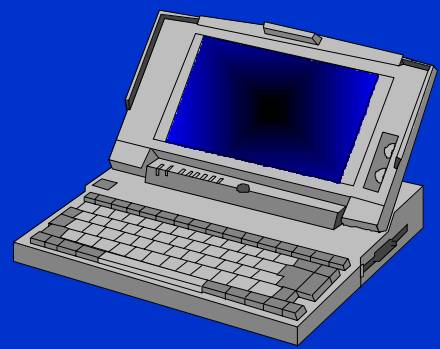
R	Treatment
1	. . . . .
2	. . . . .

TECHNOLOGY HIGHLIGHTS (Cont.)

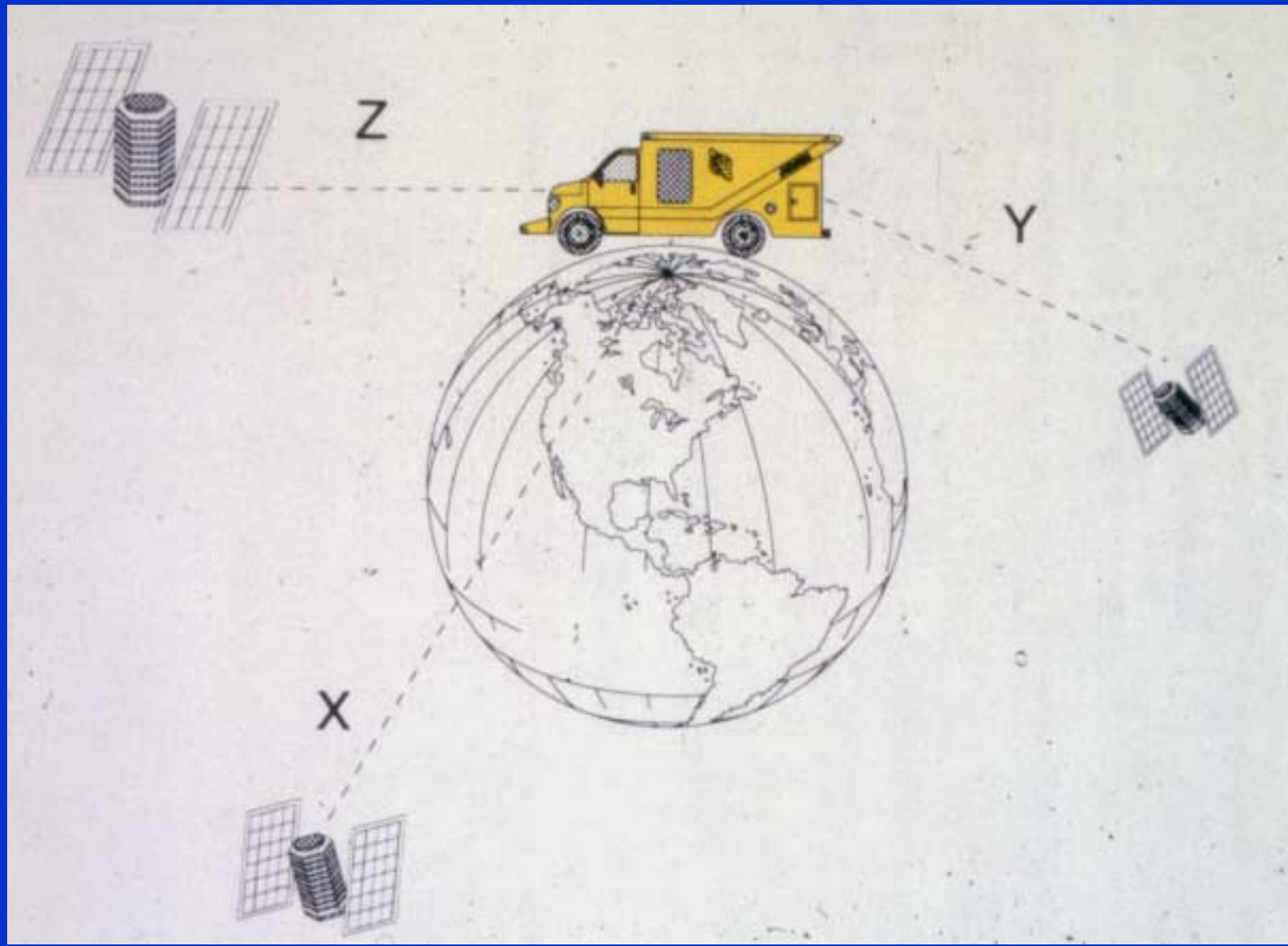
- New maintenance treatments
- New materials characterization
- High capacity computing



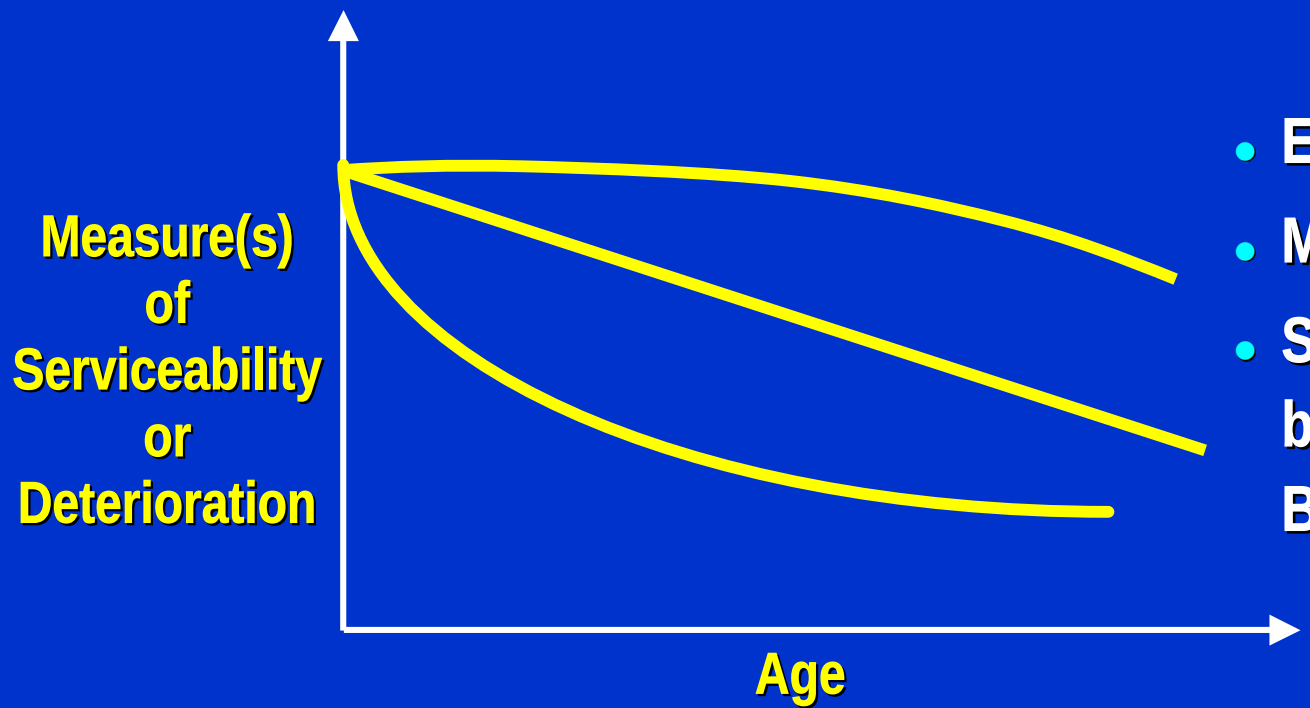




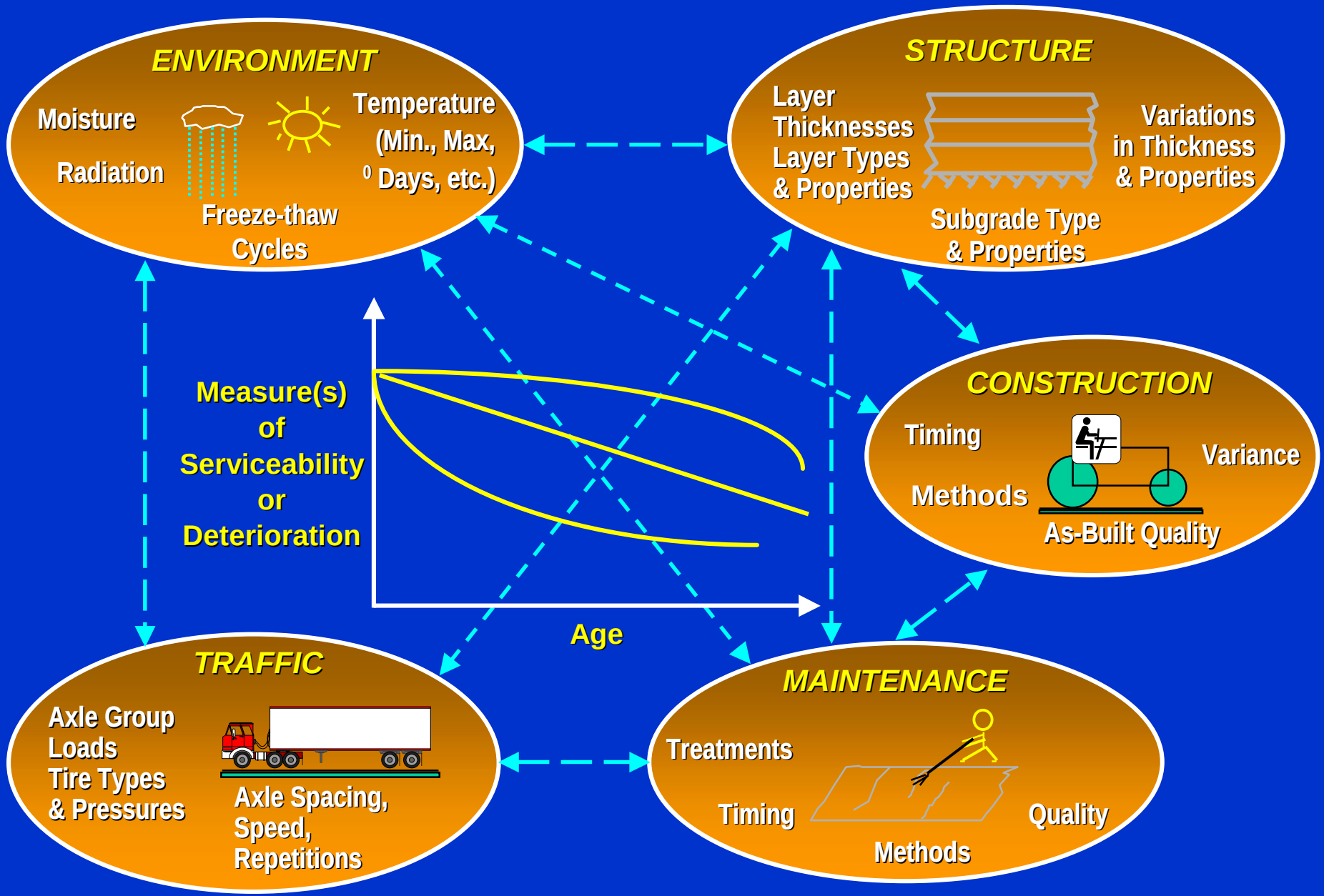

ROAD TESTER
3000
EMENT VIEW
CAMERA
MULTIPLE
SVHS RECORDERS
VIDEO MONITORS
CENTRAL PROCESSING
R.O.W. CAMERA
SIGN CAMERA
REMOTE CAMERA
POSITIONING
SURFACE CONDITION
INVENTORY PROCESSOR
TRANSVERSE
PROFILE
BUMPER
RT 3000
TRANSDUCERS
TIME CODE GENERATOR
SPECIAL EFFECTS
GENERATOR
MASS MEDIA
DATA STORAGE
ON-BOARD
VIDEO
DATA LIBRARY
TIME CODE
AFTERBURNER

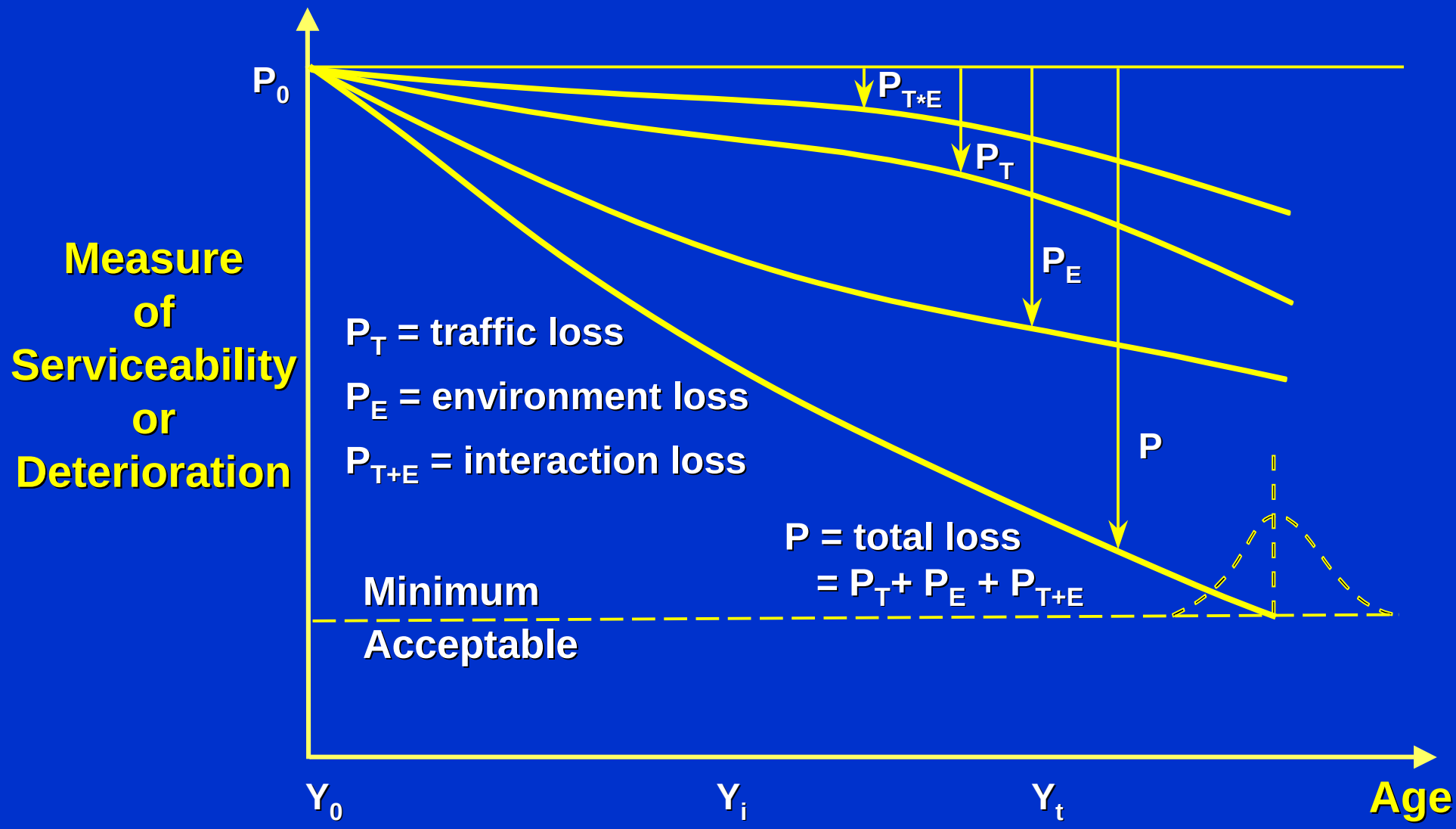

Z
Y
X

PERFORMANCE MODELLING

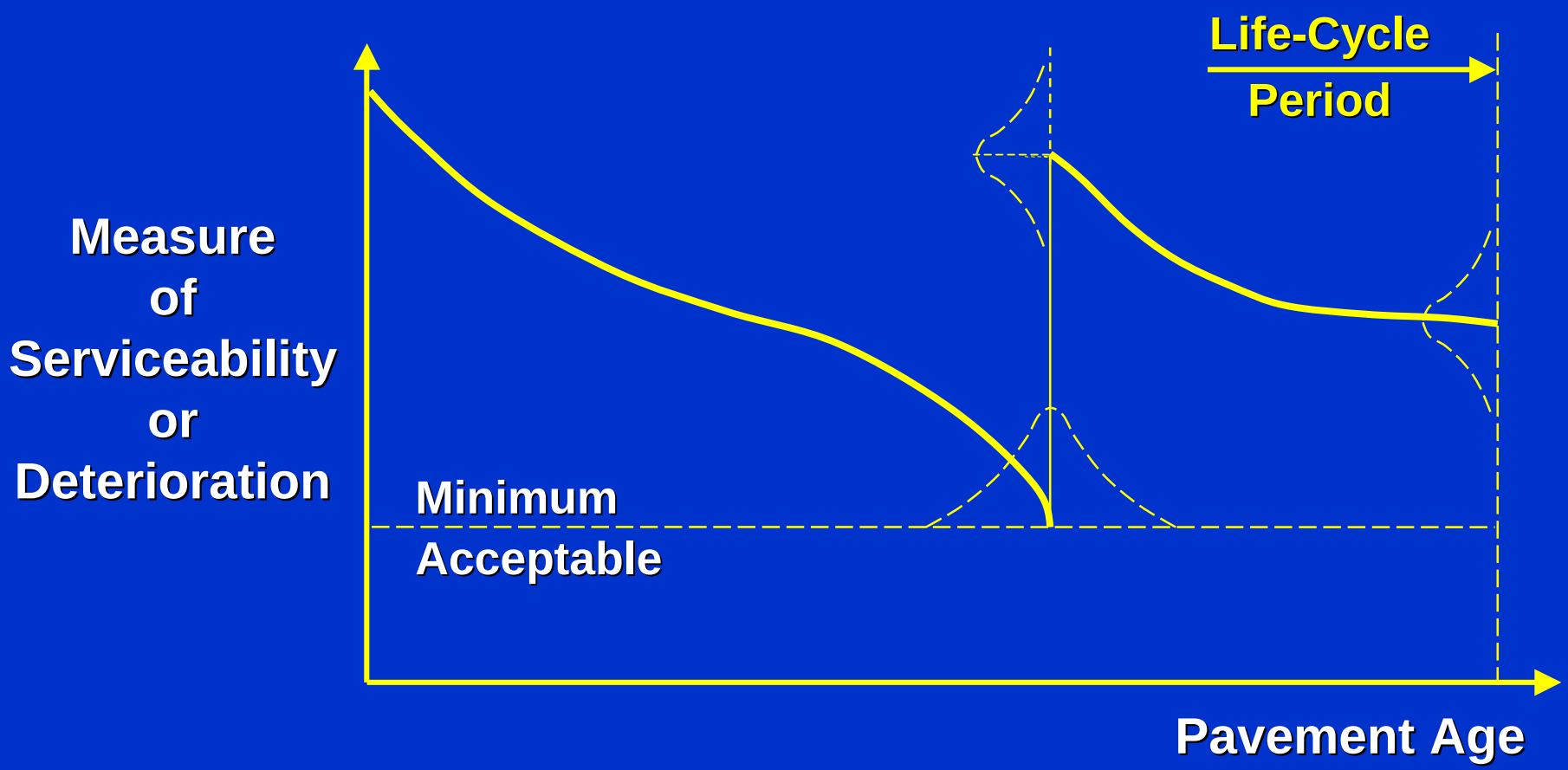


- Empirical (e.g. regression)
- Mechanistic-empirical
- Subjective / experience based (e.g. Markov Bayesion)


ENVIRONMENT
Moisture
Radiation
Temperature
(Min., Max,
0 Days, etc.)
Freeze-thaw
Cycles
STRUCTURE
Layer
Thicknesses
Layer Types
& Properties
Variations
in Thickness
& Properties
Subgrade Type
& Properties
Measure(s)
of
Serviceability
or
Deterioration
Age
CONSTRUCTION
Timing
Variance
Methods
As-Built Quality
TRAFFIC
Axle Group
Loads
Tire Types
& Pressures
Axle Spacing,
Speed,
Repetitions
MAINTENANCE
Treatments
Timing
Quality
Methods

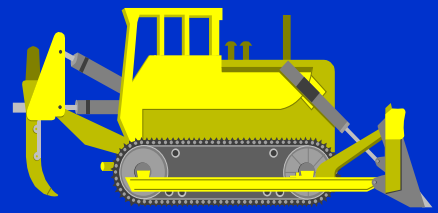

Measure of Serviceability or Deterioration
P_0
P_{T*E}
P_T
P_E
P
P_T = traffic loss
P_E = environment loss
P_{T+E} = interaction loss
P = total loss
= P_T+ P_E + P_{T+E}
Minimum Acceptable
Y_0
Y_i
Y_t
Age

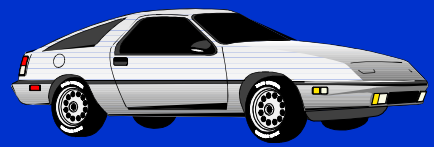
LIFE CYCLE ANALYSIS



USER COSTS

- Delays due to maintenance and rehabilitation
- Vehicle operating costs
- Accidents
- Discomfort, etc.

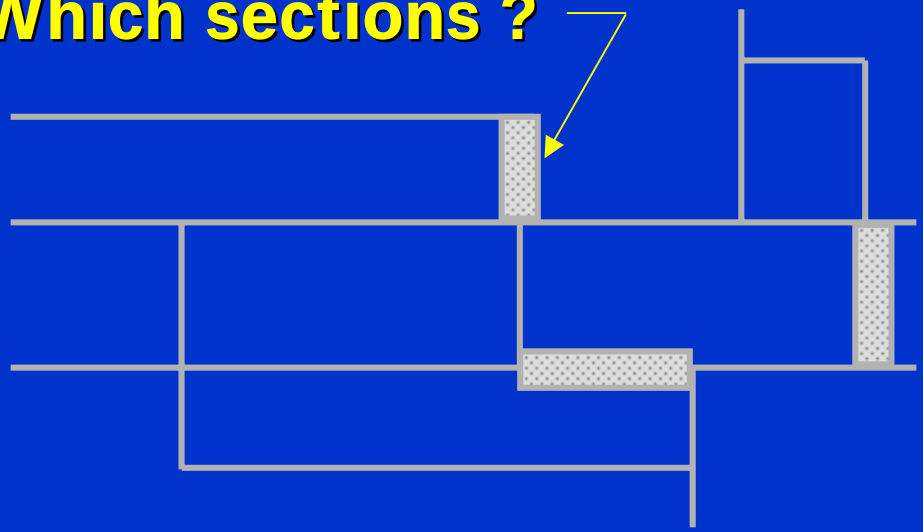




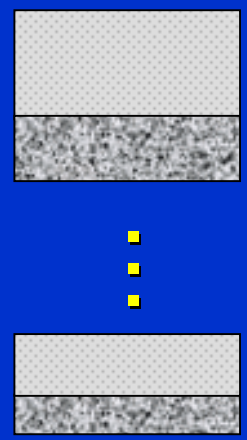
NETWORK LEVEL, MULTI-YEAR PRIORITIZATION

Optimal Combination of:

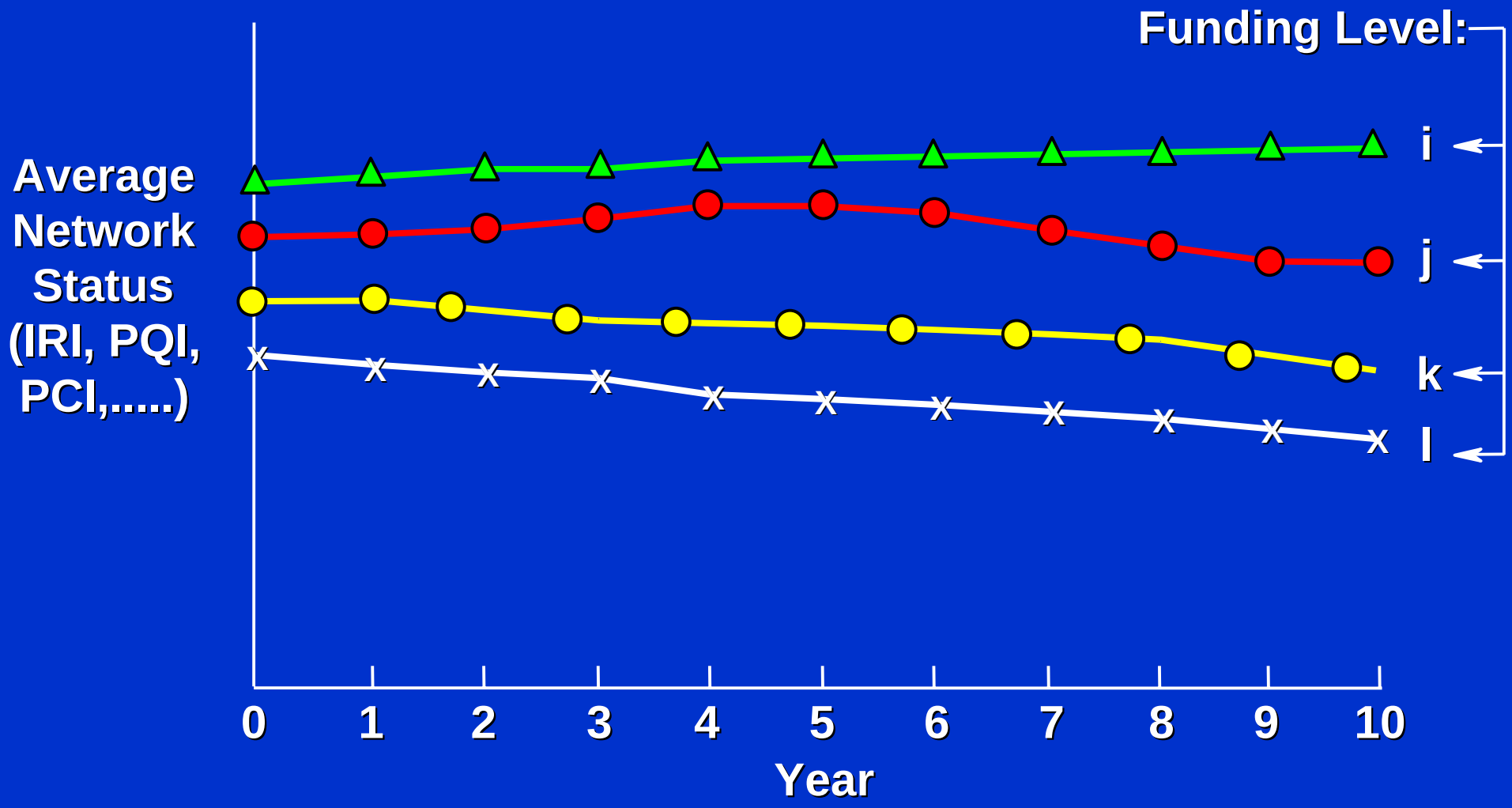
Which sections ?

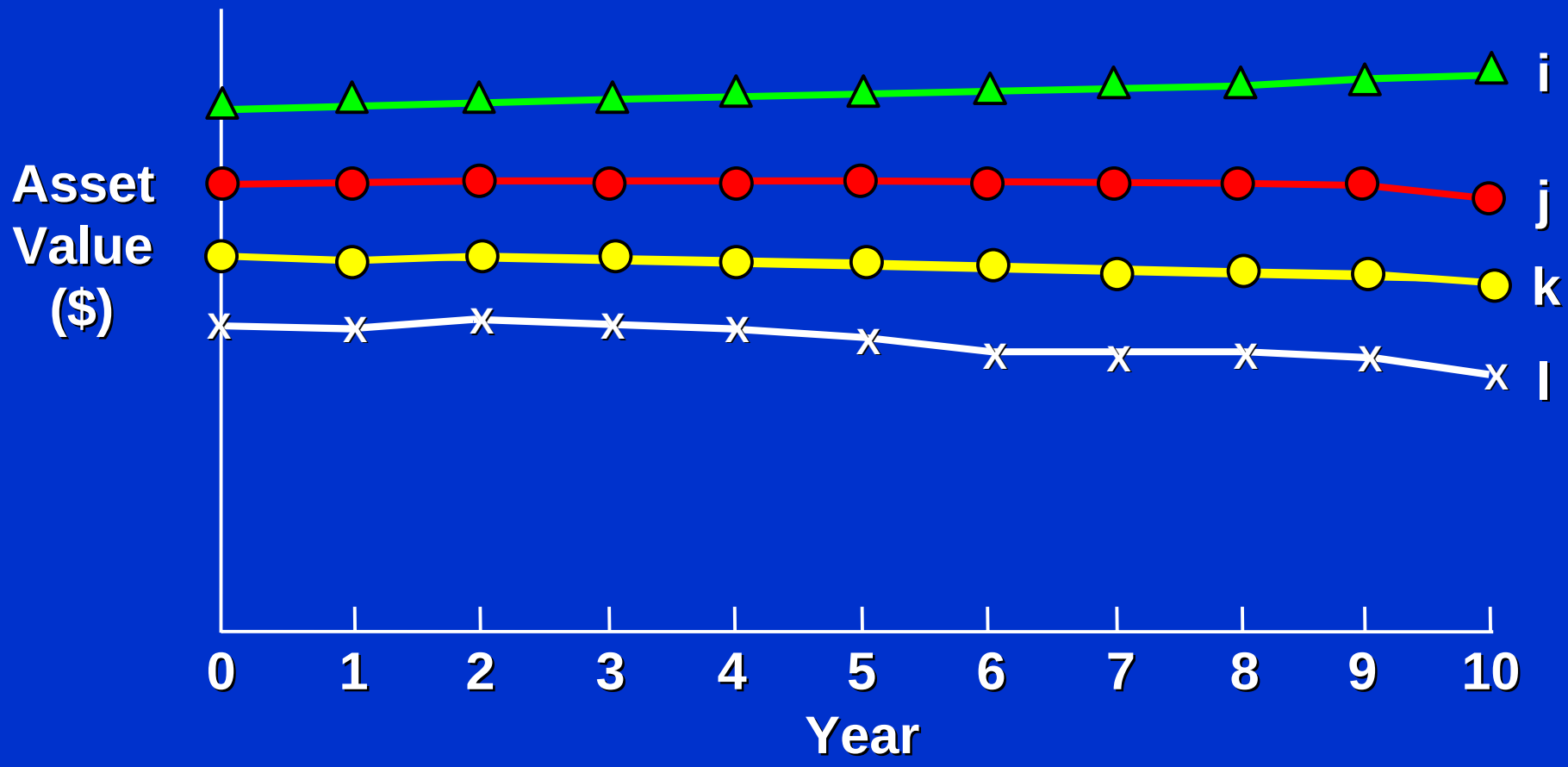


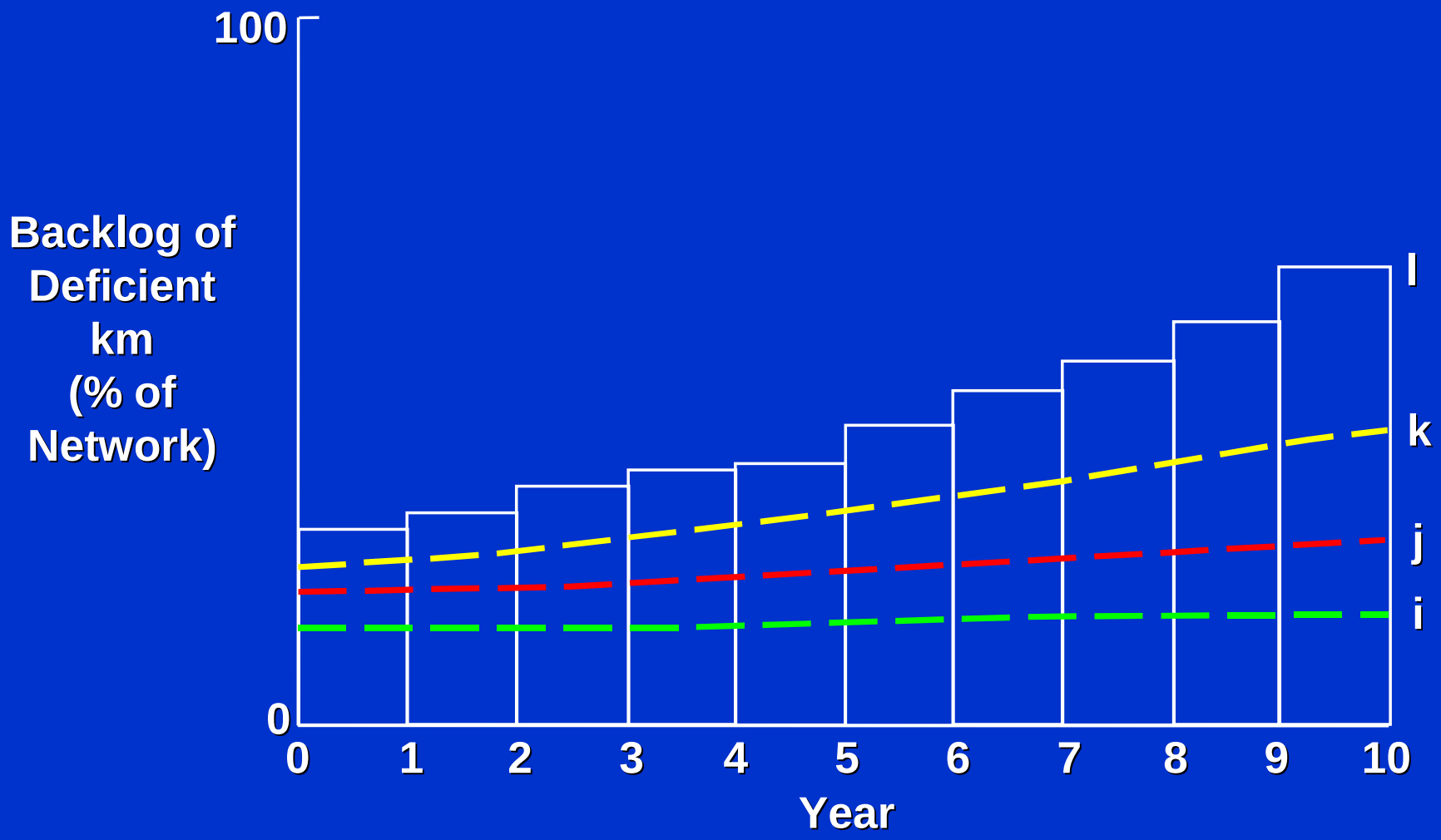
What treatments ?



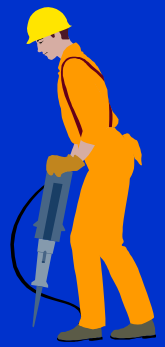
When (in program period), for funding level “i” ?

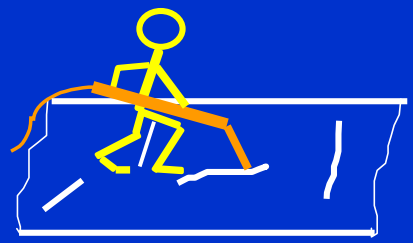

Funding Level:
i
j
k
l
Average Network Status (IRI, PQI, PCI,.....)
0
1
2
3
4
5
6
7
8
9
10
Year


Asset Value ($)
i
j
k
l
0
1
2
3
4
5
6
7
8
9
10
Year

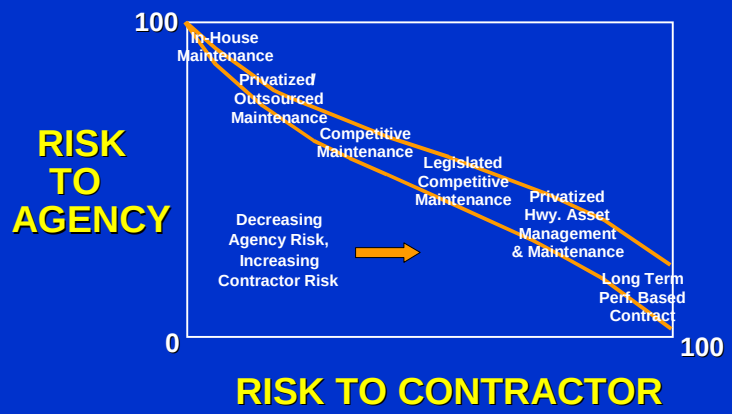

100
Backlog of Deficient km (% of Network)
0
0
1
2
3
4
5
6
7
8
9
10
Year
l
k
j
i

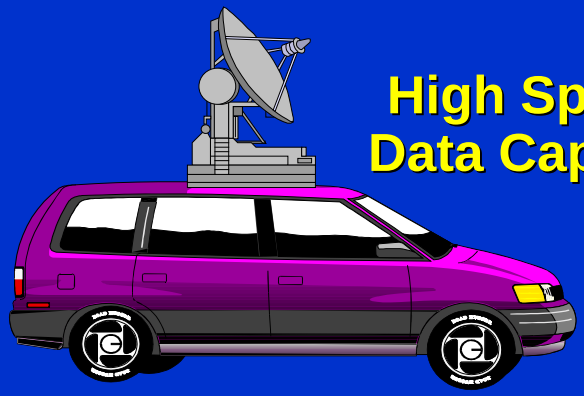
MAINTENANCE





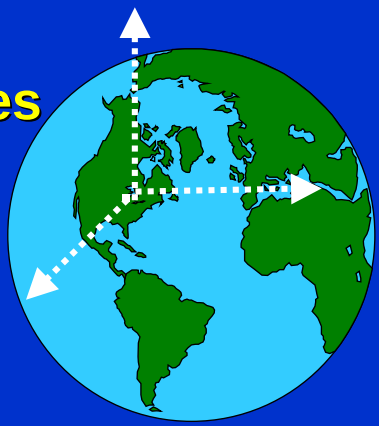
- 1970's … Effectiveness of crack rout and seal
- 1980's … Large scale privatization of maintenance
- 1990's … Demonstration of effectiveness of preventive maintenance treatments

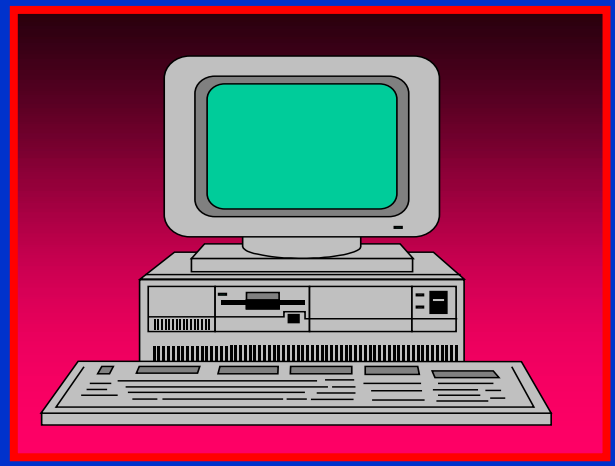


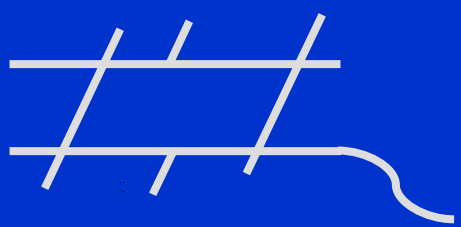


High Speed
Data Capture

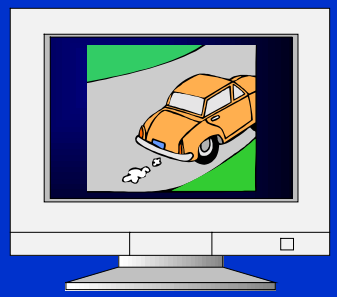
Relational Databases
and GIS Platform



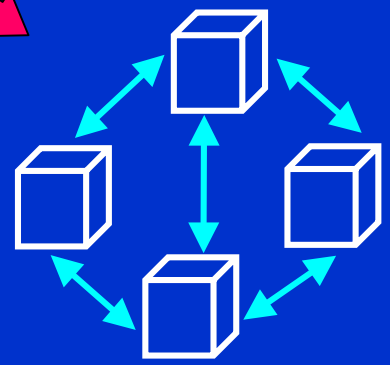




Network Level
Optimization



Analyses and
Visual Interaction



Multi-Factor
Sensitivity Testing

KEY ISSUES

1. Institutional / administrative
2. Data
3. Database
4. Engineering
5. System

Facing the issues reduces the need for reinvention

MAJOR REINVENTION / INVENTION NEEDS

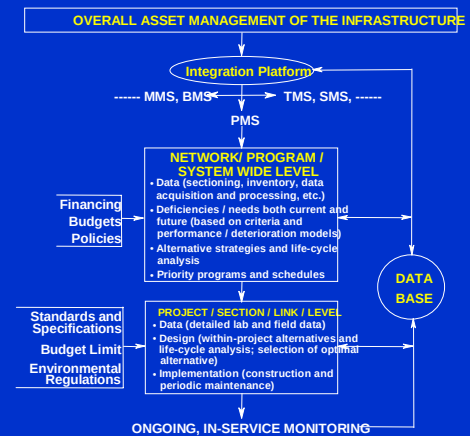
1. Institutional

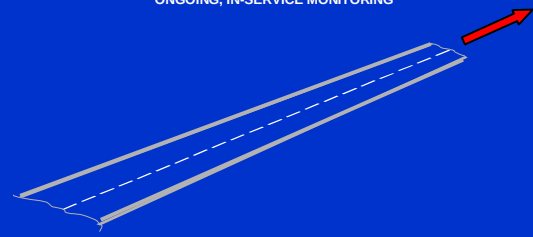
- Succession Planning
- Integrating PMS with Asset Management
- Adapting PMS to Privatization

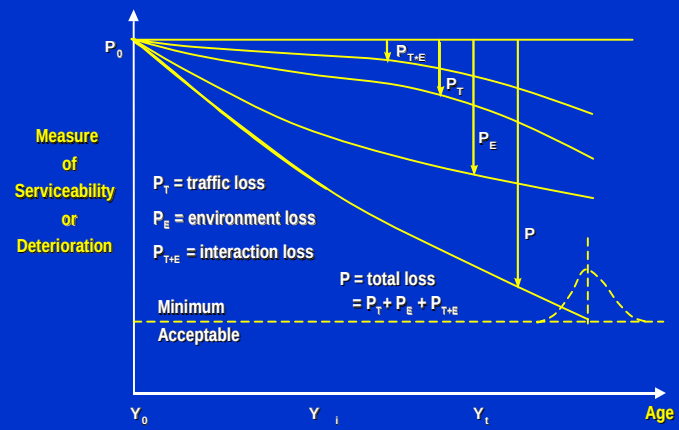
MAJOR REINVENTION / INVENTION NEEDS

2. Technical

- Interfacing Network and Project Levels
- Longer Lasting, Better Quality Pavements
- Performance Models Which Separate Traffic and Environment Effects

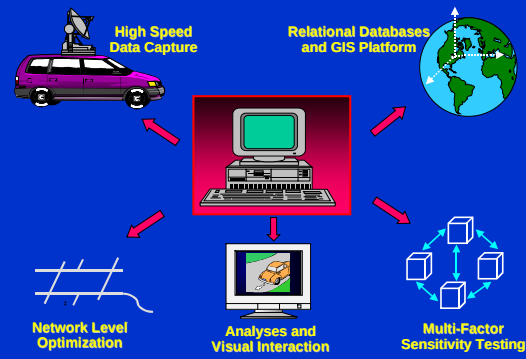






MAJOR REINVENTION / INVENTION NEEDS

3. Economic and Life Cycle

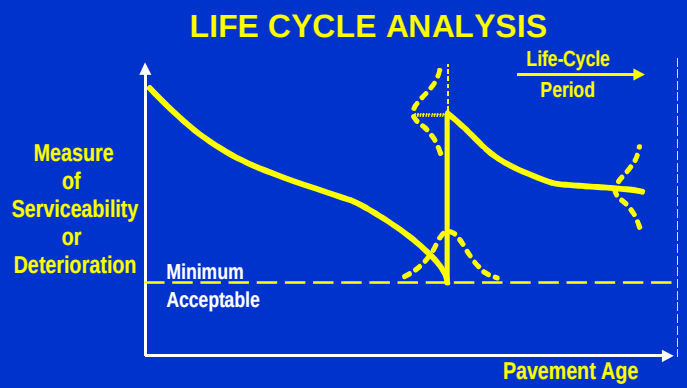


- Quantifying Benefits

$

- Incentive Programs

- Very Long Term Life Cycle Analysis Protocols



FUTURE EXPECTATIONS AND OPPORTUNITIES

Challenge !

“ … Seize the opportunities and advance the process, technology and use of pavement management. Keep pavement management dynamic; innovate; resolve your institutional barriers; educate the new people including new administrators; strive for quality; communicate; take risks; be proactive, not reactive; and make pavement management a truly effective decision support tool for all agency levels.”

FUTURE EXPECTATIONS AND OPPORTUNITIES

Realistic Expectations

- Increasing integration
- Most existing issues will remain, to varying degrees
- Progress will occur on reinvention / invention needs (how much incremental vs. how much quantum progress ?)

FUTURE EXPECTATIONS AND OPPORTUNITIES

Realistic Expectations (Continued)

- SHRP will provide technology benefits but cannot meet all needs
- Increasing challenge to justify C/E of data collection and effectiveness of PMS in preserving asset value
- Increasing globalization of technology transfer, marketing and web based availability of information and technology

FUTURE EXPECTATIONS AND OPPORTUNITIES

More Idealistic Expectations

- Quantum increase in pavement life, lower maintenance and user costs
- Widespread adoption of succession planning strategies
- New SHRP program → innovation, less short-term emphasis on “products”, construction technologies, etc.

FUTURE EXPECTATIONS AND OPPORTUNITIES

More Idealistic Expectations (Continued)

- Substantial grant $$ for high risk, innovative ideas
- Comprehensive protocols for very long life cycle analysis
- Comprehensive protocol on long term performance specifications, and privatization
- Objective and widely accepted protocol for comparing rigid and flexible

FUTURE EXPECTATIONS AND OPPORTUNITIES

A Key Opportunity:

Ensuring that asset management effectively incorporates existing, well established systems; eg., PMS and BMS

CONCLUSIONS

Pavement management has seen widespread and successful application. Key ingredients include a sound concept, learning from experience and a solid foundation of technology. Issues to be resolved are institutional, data, engineering and system based; also major reinvention / invention needs, which can be turned into opportunities. The future lies in continuing technology advances, risk taking and innovation and effective integration with overall asset management.