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-- **Benchmarking Successful Companies –
Michael Hernu – Solomon & Associates
*Lessons to Be Learned Across Sectors***



Michael Hernu

Management Consultant

- **SOLOMON & ASSOCIATES**

- ✓ **Benchmarking Assessments**
- ✓ **Multi-Industry Sectors Specialists**



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Twenty Years of Process Industry Benchmarking



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Benchmarking

Introduction to BM Studies

BM Study Peer Groups

Performance Indices

Causal Factors

Use of Benchmarks

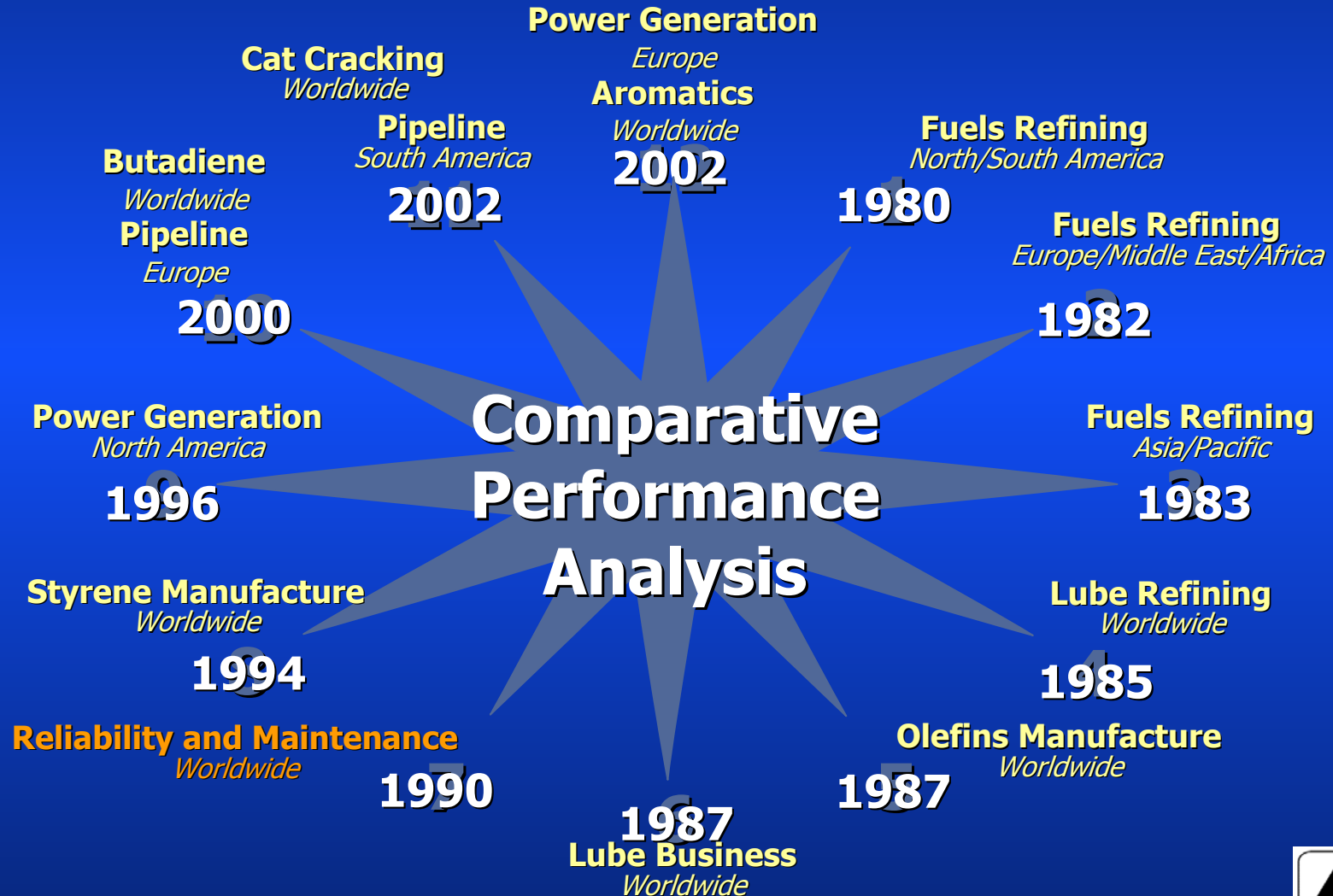
Some Observations

Benchmarking

Introduction to BM Studies



Solomon BM Studies



BM Studies Worldwide

Power 20%
America, Europe

Pipeline 35%
Europe, Latin America



Fuels - 85% Worldwide
Lubes - 50% Worldwide

Olefins - 75% Worldwide
Butadiene - 35% Worldwide
Styrene - 30% Worldwide



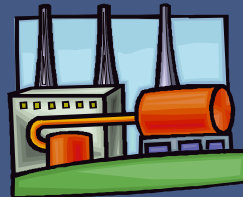
Reliability and Maintenance



Other
Raw
Materials



Other
Process
Industries



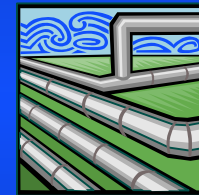
Refineries



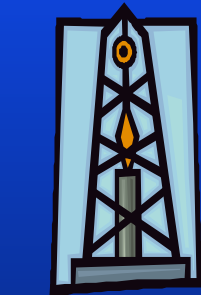
Chemicals



Tankage



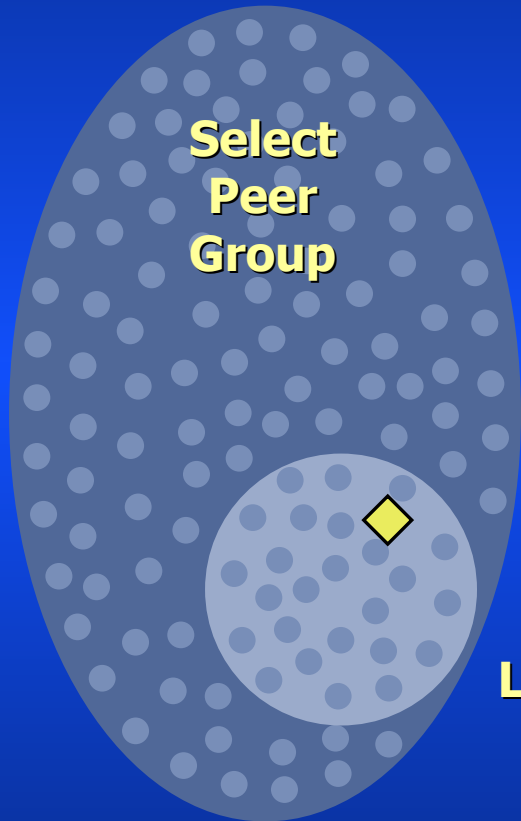
Pipelines



Exploration/
Production

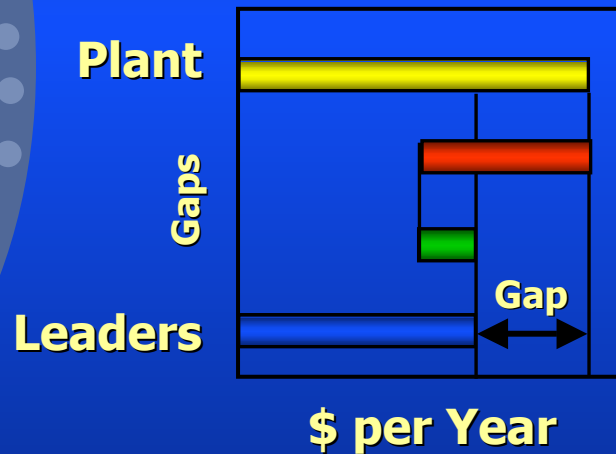
**Reliability and
Maintenance Study**

The Benchmarking Process

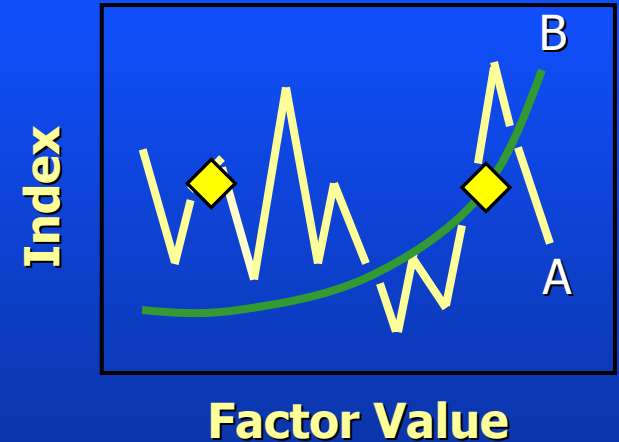


Population

Measure Opportunity Gaps



Discover Causal Factors



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Process Peer Groups

Chemicals and Refinery

Chemical Processes

- Olefins
- Olefin Intermediates
- Chlorinated Hydrocarbons
- Primary Aromatics
- Aromatics Intermediates
- Polyolefins
- Thermoplastics & Elastomers
- Pharmaceutical & Agricultural
- Chlor-Alkali
- Utilities and Offsites

Refinery Processes

- Atmospheric Distillation
- Vacuum Distillation
- Fluid Catalytic Cracker
- Hydrocracker
- Catalytic Reformer
- Alkylation
- Coker
- Distillate Hydrotreater
- Sulphur Recovery
- Utilities and Offsites



Process Peer Groups

Pulp and Paper Mills

Pulp and Paper Mills Processes

- Wood Yard
- Digesters
 - ✓ Continuous
 - ✓ Batch
- Boilers
- Recycle Paper Plant
- Utilities
- Refiner
- Paper Machine
 - ✓ Pulp
 - ✓ Kraft
 - ✓ Board
 - ✓ Fine Paper

Regional Peer Groups

- **North America, Canada and Australia**
- **Latin America**
- **Western Europe**
- **Eastern Europe, Middle East, Africa and Asia**
- **Japan**



Benchmarking

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BM Study Peer Groups

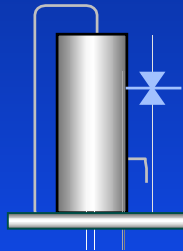
Performance Indices

Performance Indices

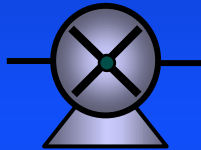
- **Five components of routine and turnaround Maintenance effectiveness are benchmarked:**
 - ✓ **Lost margin due to outage (valued at 40% of plant replacement value per annum)**
 - ✓ **Direct costs (craftsmen, contractors and materials)**
 - ✓ **Support costs (supervision, indirects and consumables)**
 - ✓ **Interest on spares inventory (valued at 20% of material replacement value per annum)**
 - ✓ **Operator work (administration, preparation and tasks)**



Maintenance Categories



Fixed plant and civil



Rotating equipment



Electrical equipment



Instrumentation and controls

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Performance Indices

Causal Factors

Causal Plant Characteristics



Plant size



Location



Characteristics



Process family

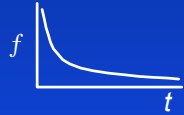


Equipment complexity



Equipment redundancy

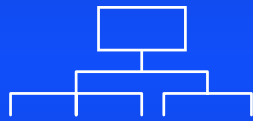
Causal Organization Factors



Reliability program

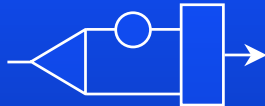


Engineering standards



Support staff

Organization structure



Procedures



Craftsmen profile

Contractor profile

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Performance Indices

Causal Factors

Use of Benchmarks

Use of Benchmarks

- Establish a plant's Performance level
- Measure causal *Plant Characteristics*
- Discover causal *Organization Factors* responsible for performance gaps with Peer Group Better Half
- Quantify Improvement Opportunities by expense type and maintenance category
- Provide a Business Case for change programs
- Convince personnel of need for new Targets



Benchmark Deliverables

- **Benchmark tables**
 - ✓ **Performance indices – average, poorer, better**
 - ✓ **Causal plant characteristics and practices – links**
- **Indices range graphs**
 - ✓ **Range of indices and causes illustrated**
 - ✓ **Plant's relative position is identified**
- **Analysis of performance gaps**
 - ✓ **Plant costs compared with Peer Group Better Half**
 - ✓ **Components of cost gaps are analyzed**
- **Plant characteristics and practices profiles**
 - ✓ **Range of characteristics and practices shown**
 - ✓ **Plant characteristics and practices compared**

Benchmark Tables – Subjects

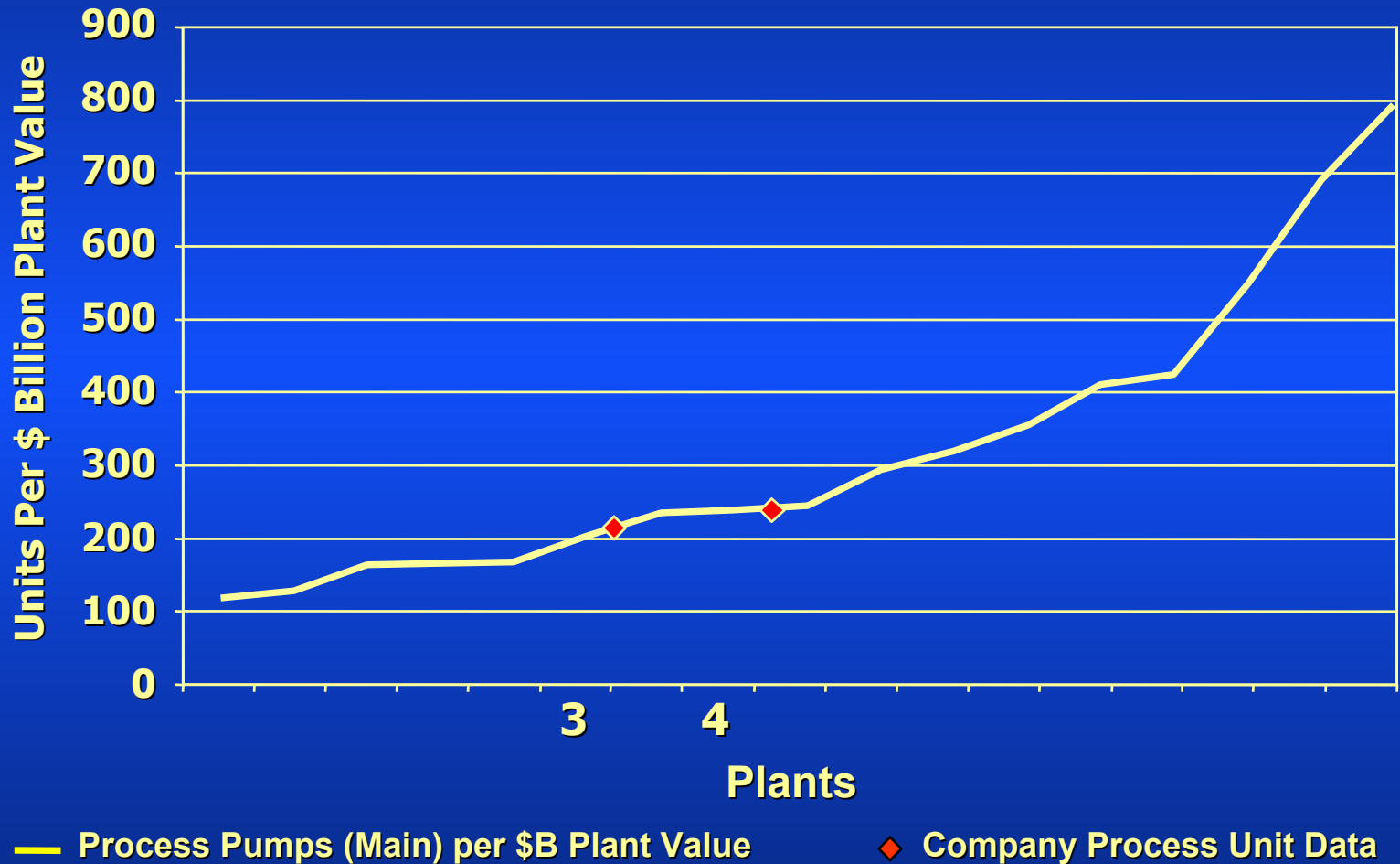
- Reliability loss indices
- Maintenance cost indices
- Spares holding cost indices
- Process severity
- Equipment redundancy
- Maintenance support
- Engineering and investment
- Reliability organization
- Work planning and scheduling
- Craftsmen characteristics
- Contracting profile
- Labor hourly costs
- Types of maintenance
- Operator maintenance indices
- Labor indices
- Materials indices
- Supervisor activity
- Craftsmen teams

Benchmark Tables

Man Hours per \$ Million Plant Value	Study Average	Reliability		Cost Index	
		Poor	Good	Poor	Good
Rotating equipment	81	106	57	108	57
Fixed plant, pipework and civil	175	224	132	245	112
Electrical equipment	29	40	18	43	16
Instrumentation and controls	56	77	37	89	28

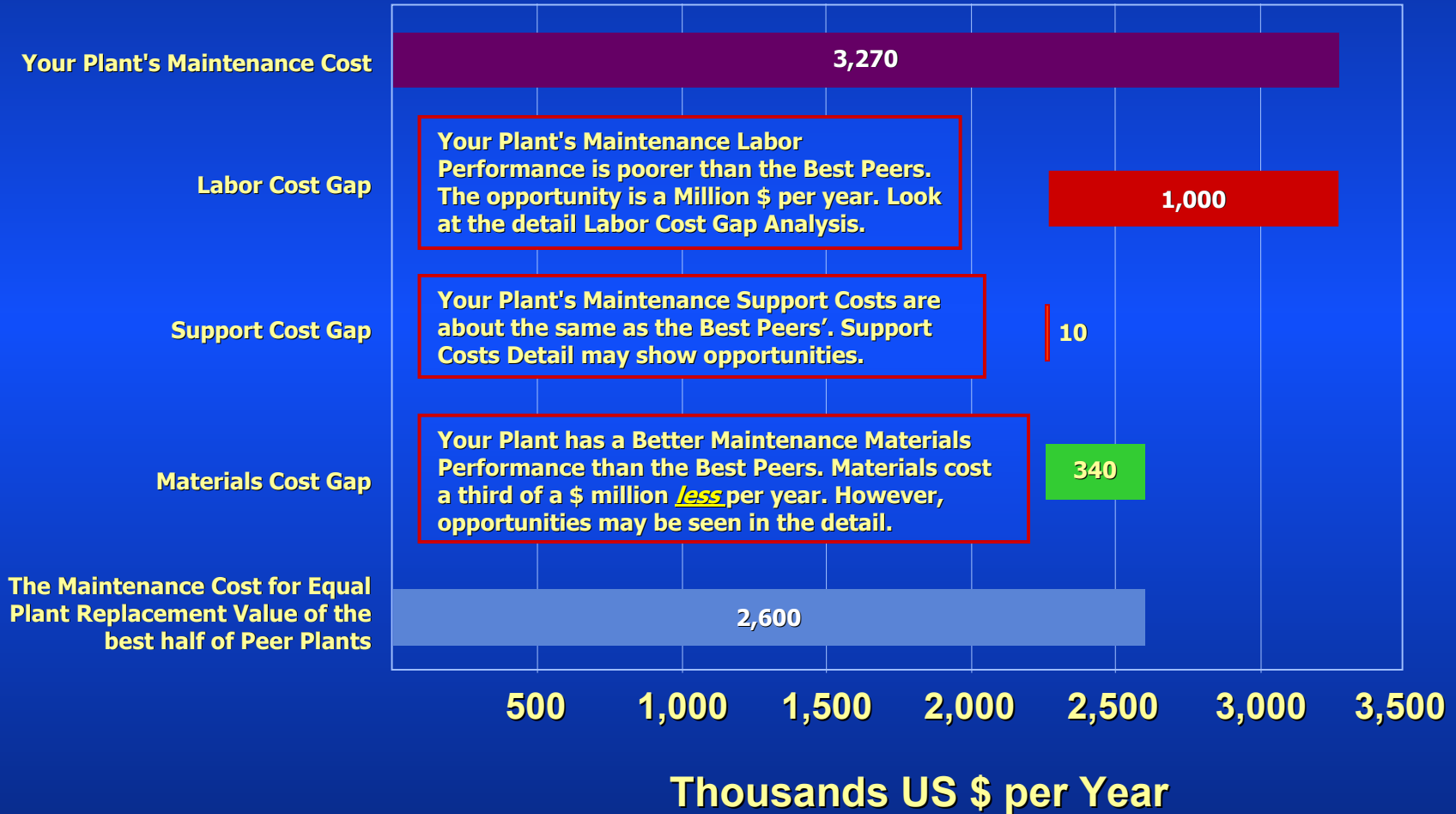


Indices Range Graphs



Analysis of Performance Gaps

Costs and Cost Gap Components



Plant and Practices Profiles

Percent of Contracts that are
Hourly Rate/Cost Plus – 80 to 100

Craftsmen's Overtime
Percent – 1 to 25

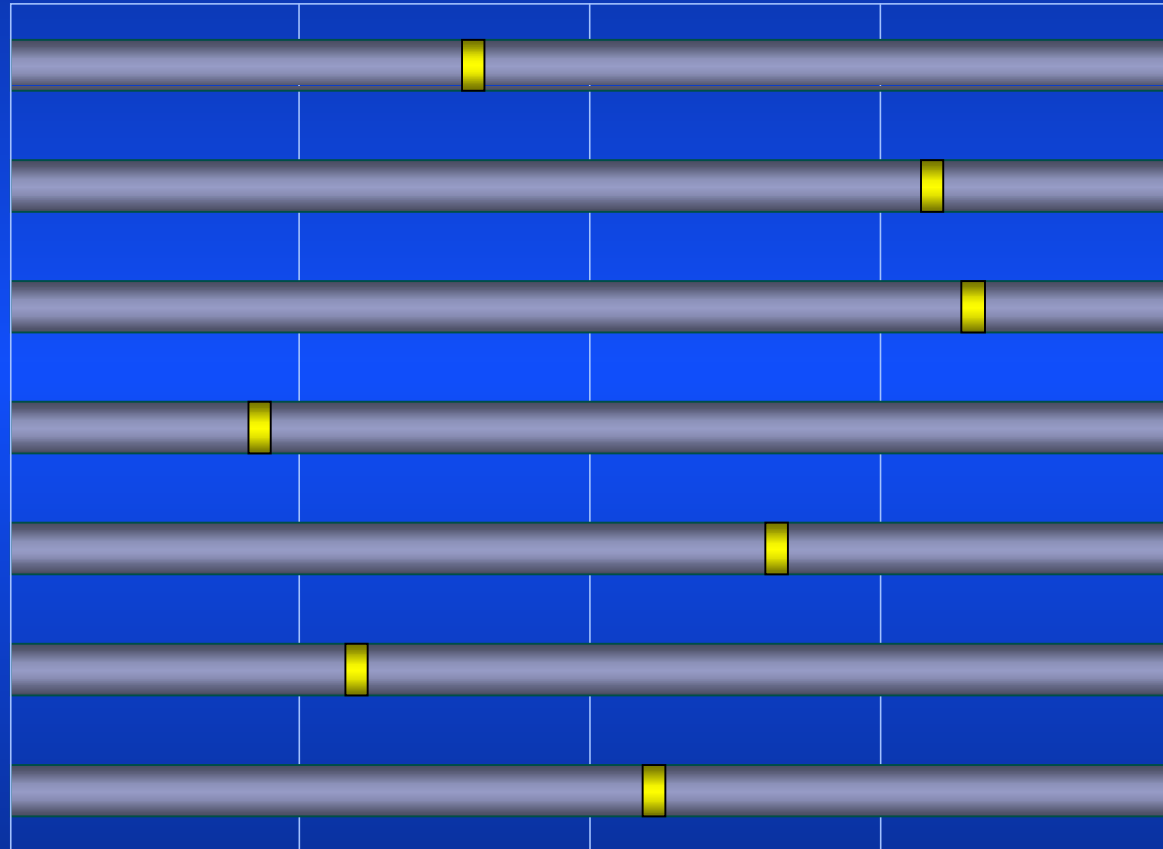
Number of Craftsmen per
Supervisor/Manager – 4 to 16

Percent of Jobs Scheduled one
week or more ahead – 0 to 93

Average time from Work Request
To Completion – days 1 to 90

Percent of Plant on Risk Based
Inspection Method – 0 to 100

Modifications per M\$PRV
per year – 0 to 0.54



Peers Range

■ Plant A



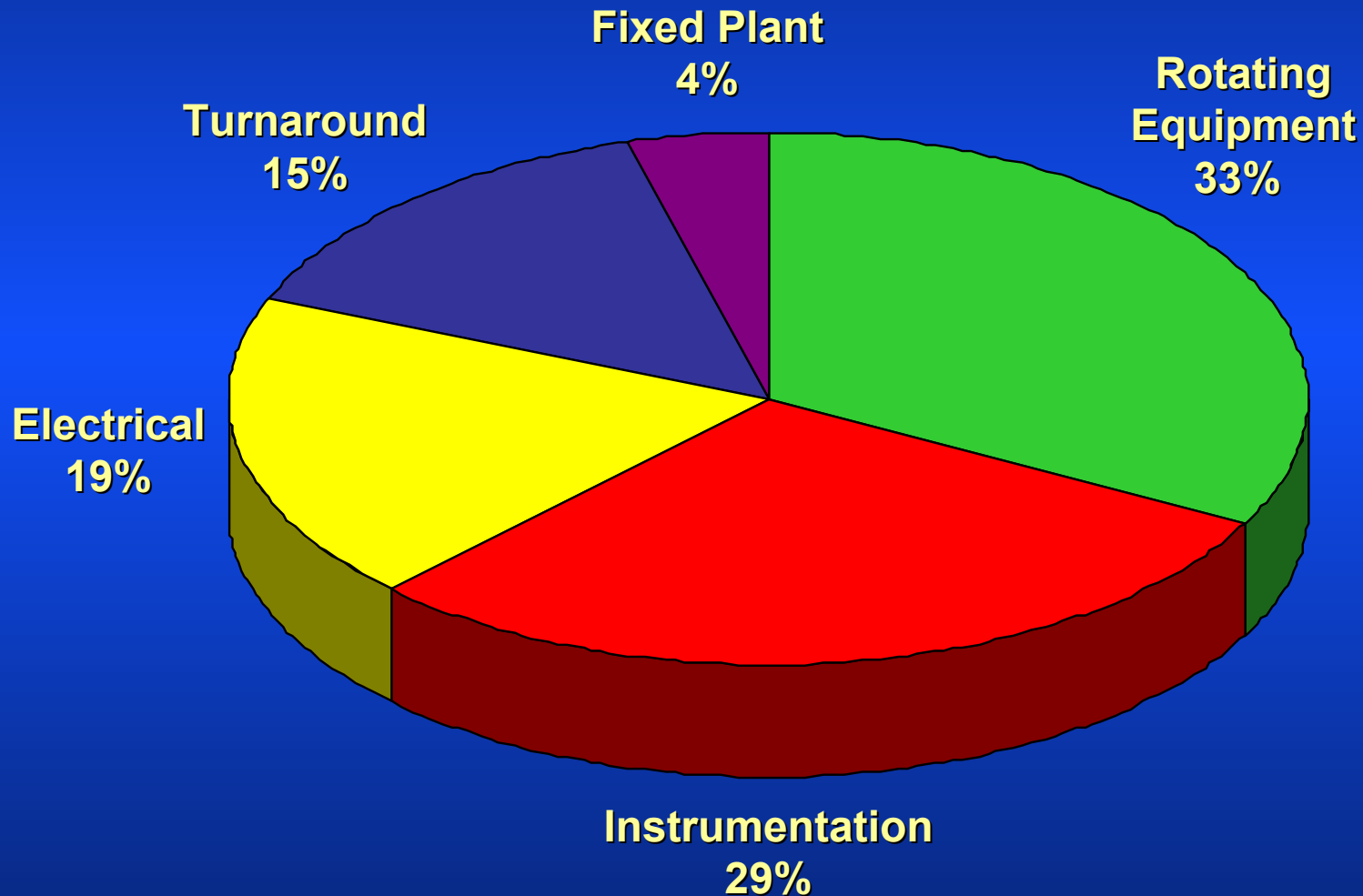
Drill Down Indices Correlation

Craftsmen's Overtime Percent	Study Average	Maintenance Index		Probability of a Correlation
		Poor1/2	Better1/2	
▪ Fixed Plant and Civil	10.4	13.7	7.3	0.98
▪ Rotating Equipment	10.9	14.3	7.5	0.93
▪ Electrical	8.3	10.5	6.2	0.70
▪ Instrumentation	11.6	14.2	9.1	0.85



Drill Down of Labor Cost Opportunities

US \$1 Million/Year – Example



Benchmarking

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Performance Indices

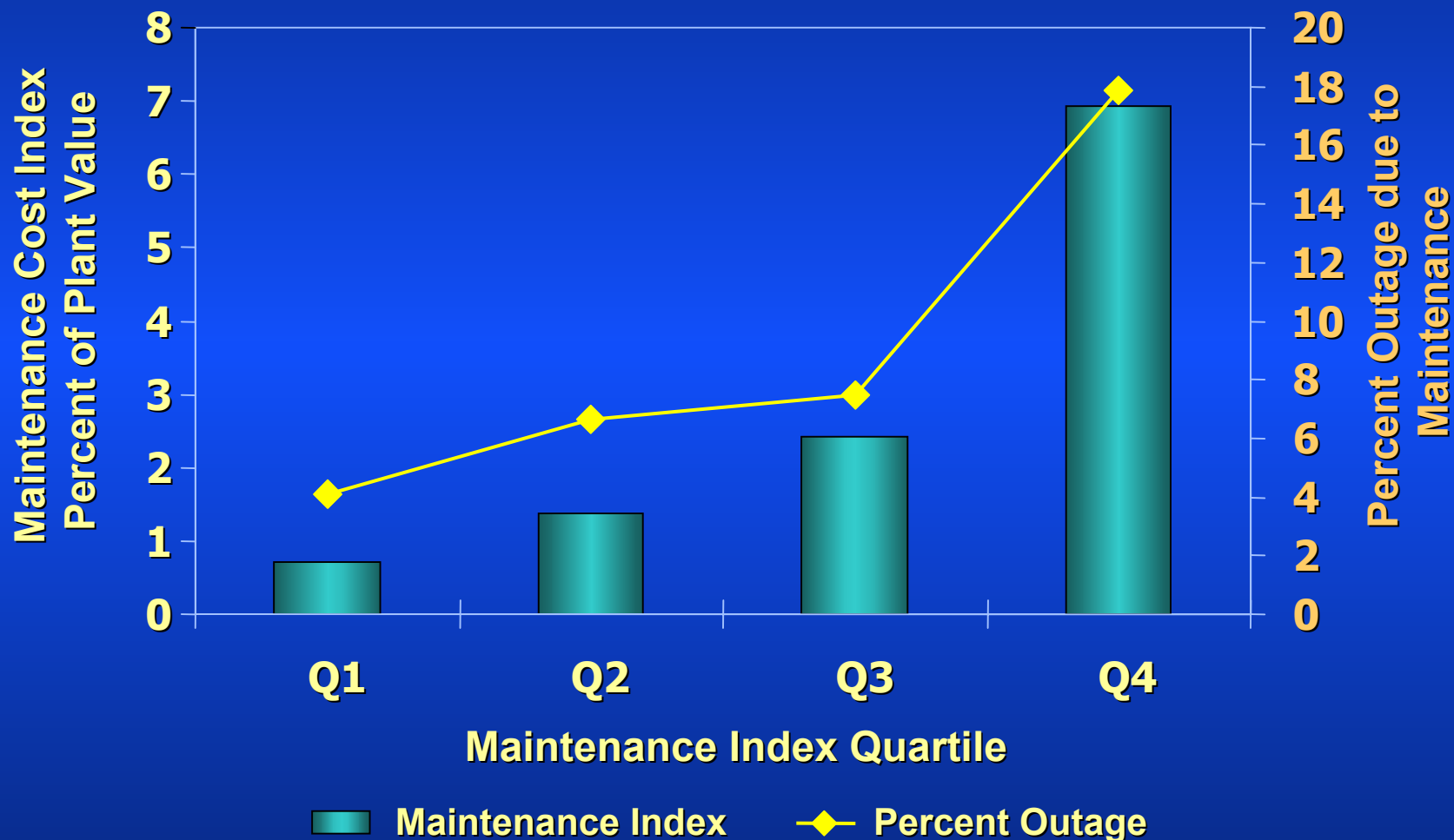
Causal Factors

Use of Benchmarks

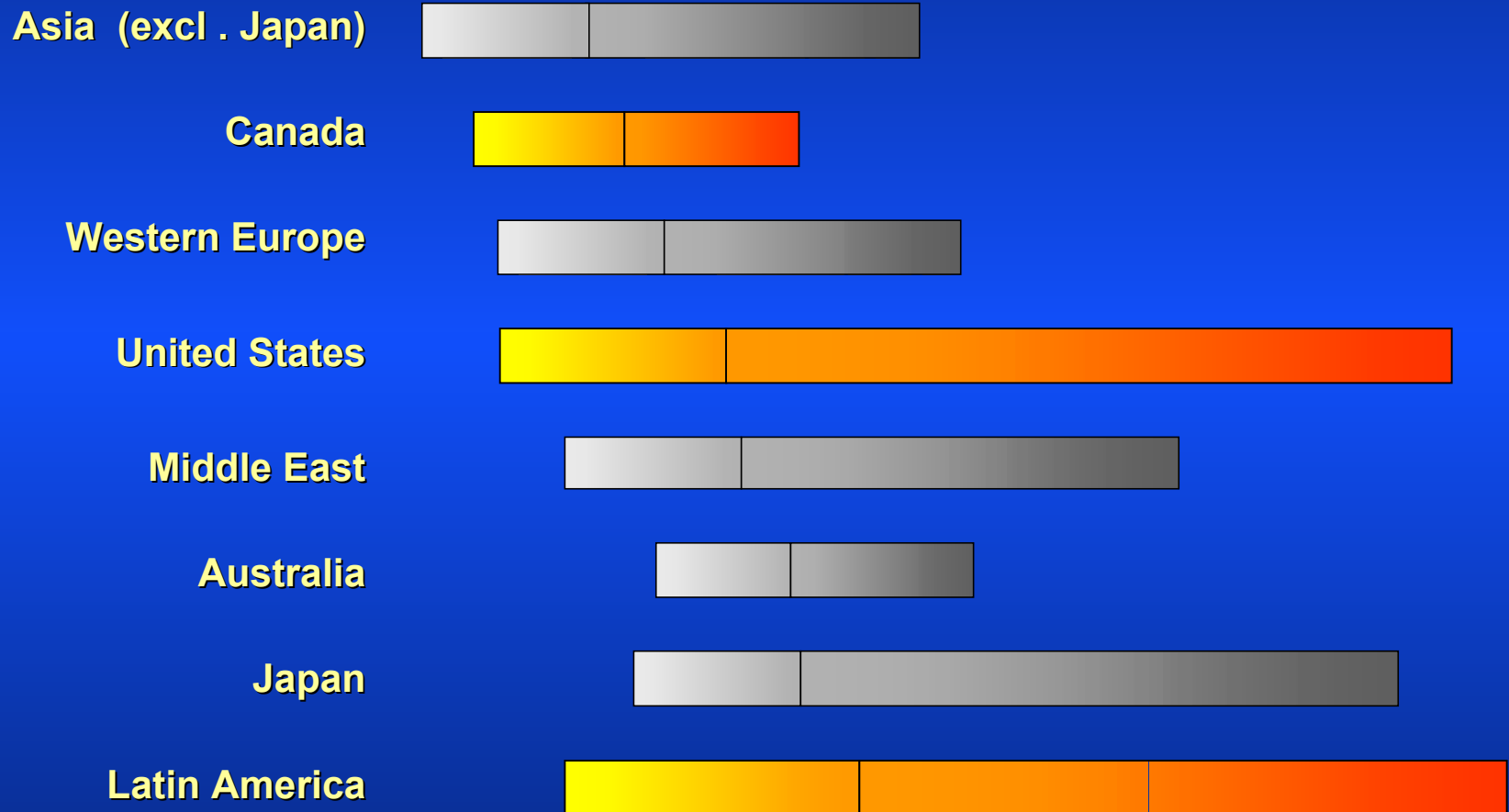
Some Observations



A Relationship Between Maintenance and Reliability Indices



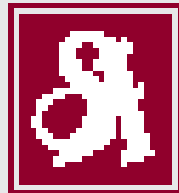
Range *Within* a Group is Greater Than *Between* Groups - Maintenance Index



Success Factors of an Improvement Program Based on Benchmarks

- Focus on the largest loss/cost gaps with peers
- Set credible performance targets that can be reached based on peer group benchmarks
- Develop KPIs at the individual level
- Review all maintenance facets: maintainability, reliability, inspection, condition monitoring, planning, scheduling, supervision and execution
- Optimize frequency as well as cost per event of all maintenance work studied
- Implement with a proven Change process

Thank You



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