

Maintenance drives manufacturing performance

This slideshow will briefly cover...

- Manufacturing performance is constrained by the maintenance practices in use
- The evolution of maintenance & manufacturing thought – *Breakdown to Lean*
- 5 Pillar TPM (Total Productive Maintenance)
- TPM fundamentals

It's purpose is to merely place things in context. Further reading is required for an in-depth understanding. You are recommended to read the following:

Introduction to TPM - by Seiichi Nakajima (A little gem! The first and the best — essential reading for every maintenance engineer & production manager)

TPM in Process Industries - editor Tokutaro Suzuki (in depth)



**Manufacturing performance
is constrained by the
maintenance practices in use**



Maintenance drives manufacturing performance



WORLD CLASS
MAUFACTURING

MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

Manufacturing performance
is *totally dependent* on
maintenance performance



Maintenance drives manufacturing performance



WORLD CLASS
MAUFACTURING

MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

Manufacturing performance is *totally dependent* on maintenance performance

Poor maintenance practices result in unreliable, quality-incapable production equipment, prone to downtime



Maintenance drives manufacturing performance



MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

Manufacturing performance is *totally dependent* on maintenance performance

Poor maintenance result in unreliable incapable product equipment, prone to down

Sub quality products with unreliable delivery dates produced at high cost



Maintenance drives manufacturing performance



MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

Manufacturing performance is *totally dependent* on maintenance performance

A realisation that came late to the world – and which is still unrecognised or resisted by many



Maintenance drives manufacturing performance



WORLD CLASS
MAUFACTURING

MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

Manufacturing performance is *totally dependent* on maintenance performance

There was - and still is - considerable inertia



Maintenance drives manufacturing performance



WORLD CLASS
MANUFACTURING

NOTE 1

MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

Too much of discrete manufacturing still remains constrained by archaic thinking and methods

Maintenance drives manufacturing performance



WORLD CLASS
MAUFACTURING

NOTE 1

MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

Too much of discrete manufacturing still remains constrained by archaic thinking and methods

Process industries have better practices - because in the 21st century an unreliable continuous process operation will simply lead to bankruptcy



Maintenance drives manufacturing performance



WORLD CLASS
MAUFACTURING

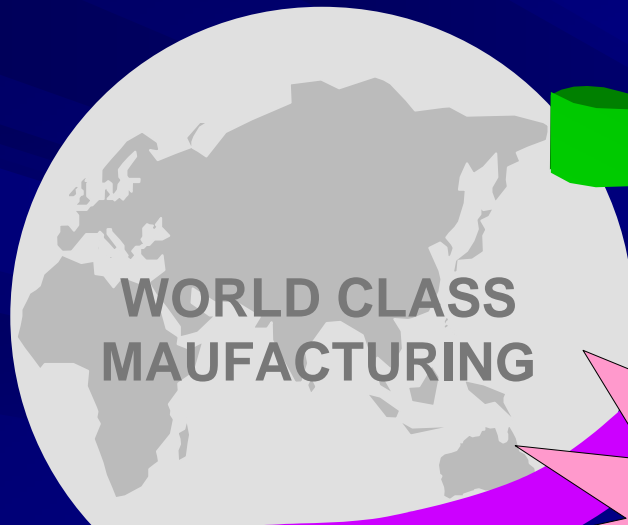
MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

NOTE 2

Entrenched attitudes, caution and inertia **still** delayed the implementation of best practice in the process industries - power, petrochem, etc

Maintenance drives manufacturing performance



MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

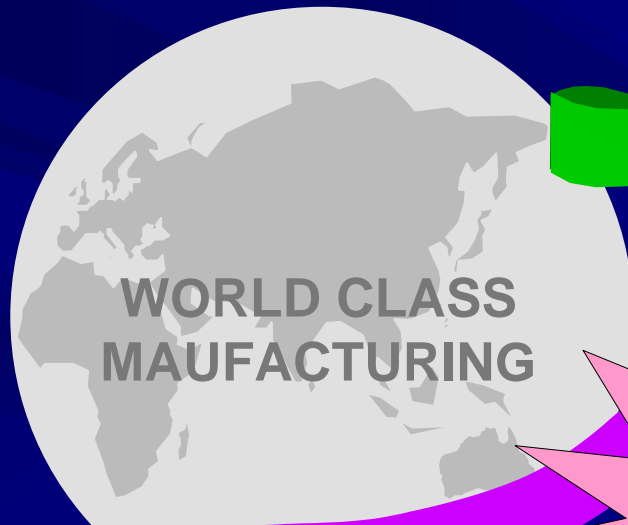


NOTE 3

**There's a 10 to 20
year gap between
maintenance leaders
and the rest of the
field**



Maintenance drives manufacturing performance



MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

There's a 10 to 20
year gap between
maintenance leaders
and the rest of the
field

...and - as the best are
getting better, the worst
remain the same

NOTE 3



The evolution of maintenance & manufacturing thought

– *from Breakdown to Lean*



Maintenance drives manufacturing performance

- *the evolution of maintenance thought*

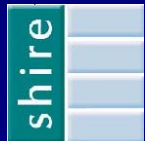


MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

1 Breakdown
Maintenance

break & fix! **1950's**



Maintenance drives manufacturing performance

- the evolution of maintenance thought



MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

1 Breakdown
Maintenance

Reactive

break & fix! **1950's**



Maintenance drives manufacturing performance

- *the evolution of maintenance thought*



MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

1 Breakdown
Maintenance

break & fix! **1950's**

Reactive

Heroic!



Maintenance drives manufacturing performance

- *the evolution of maintenance thought*



MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

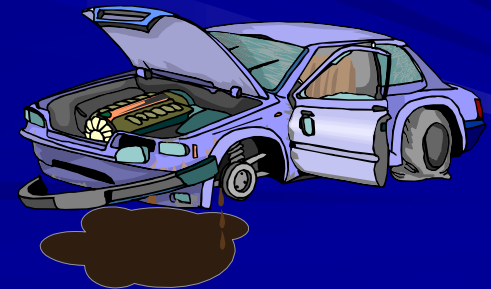
1 Breakdown
Maintenance

break & fix!

1950's

Reactive

ABUSIVE



Maintenance drives manufacturing performance

- the evolution of maintenance thought



MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

1 Breakdown Maintenance

break & fix! 1950's

2 Preventive Maintenance

avoid abuse

1960's



Maintenance drives manufacturing performance

- the evolution of maintenance thought



MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

Fixed interval invasive inspections & 'servicing'

1960's

2 Preventive Maintenance

avoid abuse

1 Breakdown Maintenance

break & fix! 1950's



Maintenance drives manufacturing performance

- the evolution of maintenance thought



MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

1 Breakdown
Maintenance

break & fix! 1950's

2 Preventive
Maintenance

avoid abuse

Costly
1960's



Maintenance drives manufacturing performance

- *the evolution of maintenance thought*



MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

1 Breakdown Maintenance

break & fix! 1950's

2 Preventive Maintenance

avoid abuse

Costly
1960's
+ Downtime



Maintenance drives manufacturing performance

- the evolution of maintenance thought



MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

1 Breakdown Maintenance

break & fix! 1950's

2 Preventive Maintenance

avoid abuse

+ Startup losses

Costly
1960's
+ Downtime



Maintenance drives manufacturing performance

- the evolution of maintenance thought



MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

1 Breakdown Maintenance

break & fix!

1950's

2 Preventive Maintenance

avoid abuse

+ Startup losses

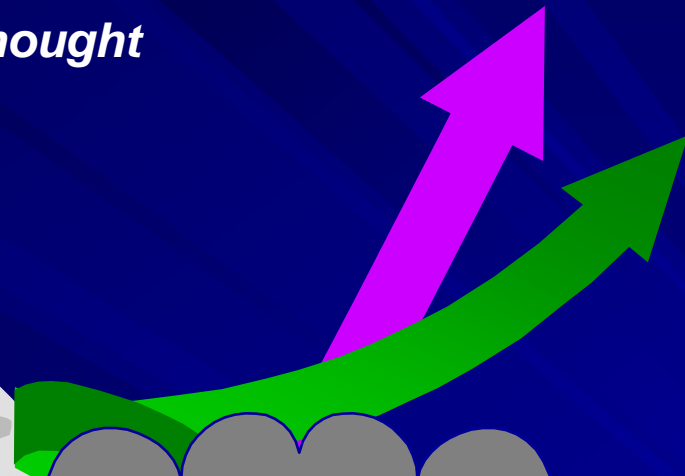
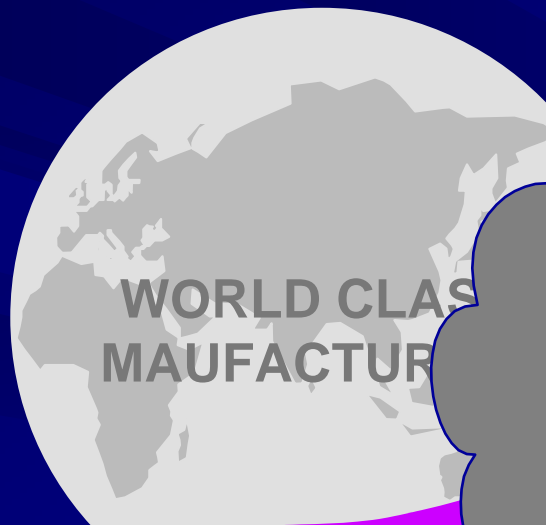
1960's

Due to the 'infant mortality' effect



Maintenance drives manufacturing performance

- the evolution of maintenance thought



Bathtub Failure Curve



MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

due to the 'infant mortality' effect

1 Breakdown Maintenance

break & fix!

1950's

2 Preventive Maintenance

avoid abuse

+ Startup losses



Maintenance drives manufacturing performance

- *the evolution of maintenance thought*



MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

1 Breakdown
Maintenance

break & fix!

1950's

2 Preventive
Maintenance

avoid abuse

1960's

3 Productive
Maintenance

avoid maintenance

1970's



Maintenance drives manufacturing performance

- the evolution of maintenance thought



MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

1 Breakdown
Maintenance

break & fix!

1950's

2 Preventive
Maintenance

avoid abuse

1960's

3 Productive
Maintenance

avoid maintenance

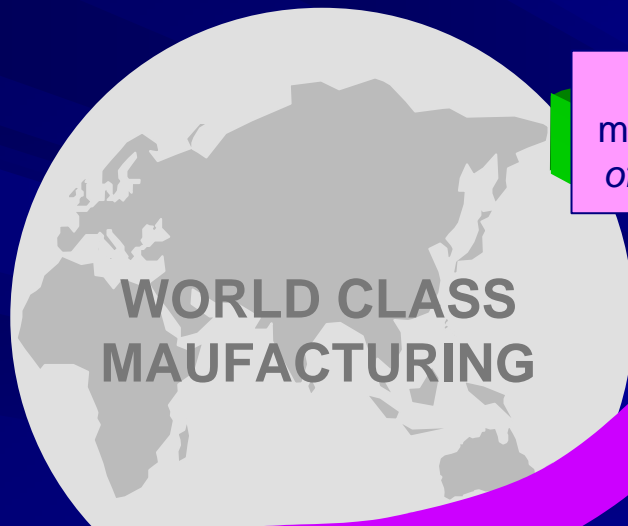
1970's

If it ain't broke,
don't fix it!



Maintenance drives manufacturing performance

- *the evolution of maintenance thought*



Pursuit of 'opportunity maintenance' – *minimisation of administrative shutdowns*

1970's

3 Productive Maintenance

avoid maintenance

MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

1960's

2 Preventive Maintenance

avoid abuse

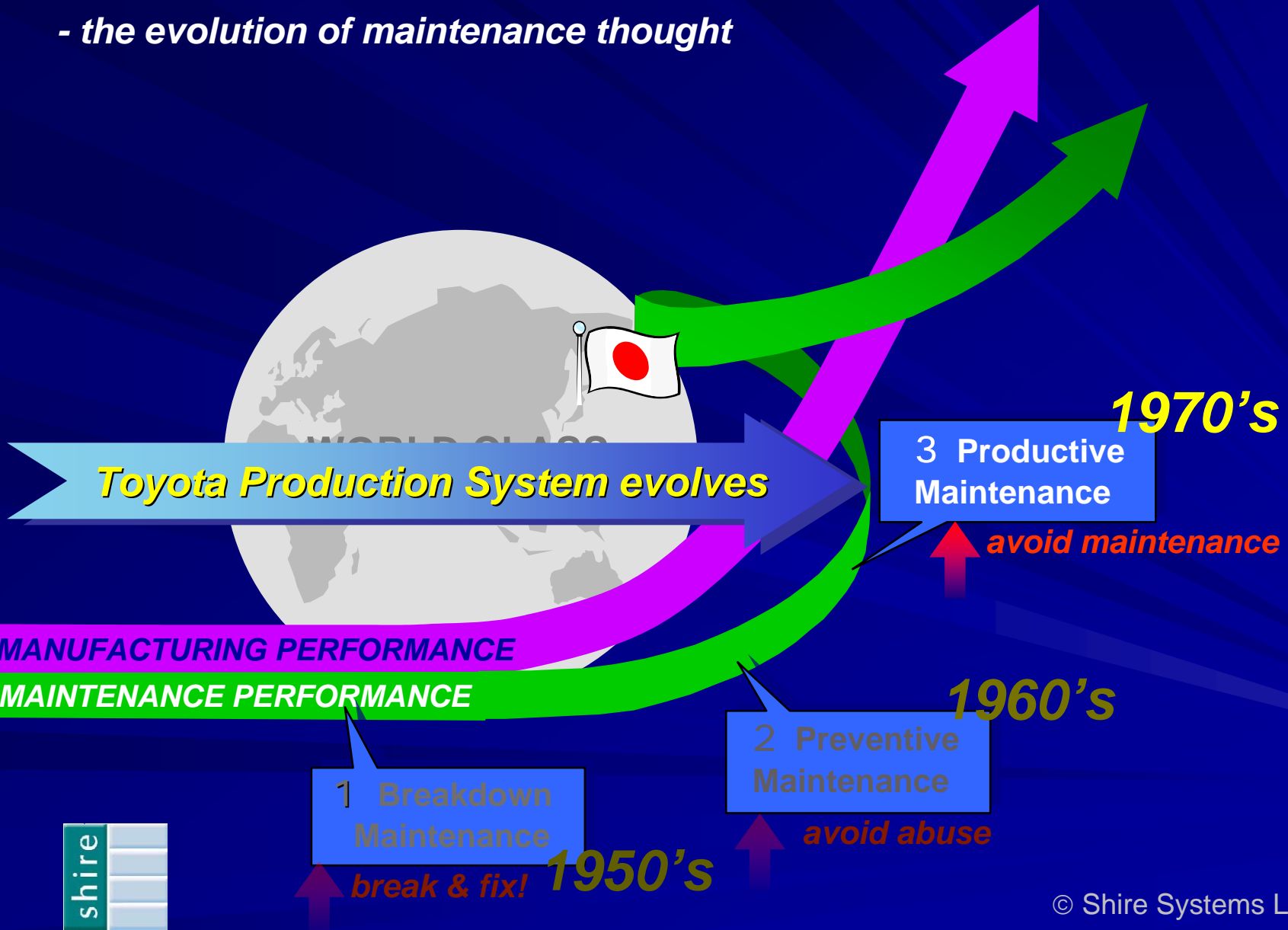
1 Breakdown Maintenance

break & fix! **1950's**



Maintenance drives manufacturing performance

- *the evolution of maintenance thought*



Maintenance drives manufacturing performance

- *the evolution of maintenance thought*

The production system developed by Toyota Motor Corporation to provide best quality, lowest cost and shortest lead time through the elimination of waste

Toyota Production System evolves

MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

1 Breakdown Maintenance

break & fix!

1950's

2 Preventive Maintenance

avoid abuse

1960's

3 Productive Maintenance

avoid maintenance

1970's

shire

Maintenance drives manufacturing performance

- the evolution of maintenance thought

Basic philosophy:

- 1. Don't make things with defects!
- 2. Don't make things you can't use or sell at once!

Toyota Production System evolves

3 Productive Maintenance

1970's

avoid maintenance

MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

2 Preventive Maintenance

1960's

avoid abuse

1 Breakdown Maintenance

1950's

break & fix!



Maintenance drives manufacturing performance

- the evolution of maintenance thought

Basic philosophy:

- 1. Don't make things with defects!
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Six Sigma

JIT

Toyota Production System evolves

3 Productive Maintenance

avoid maintenance

1970's

MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

2 Preventive Maintenance

avoid abuse

1960's

1 Breakdown Maintenance

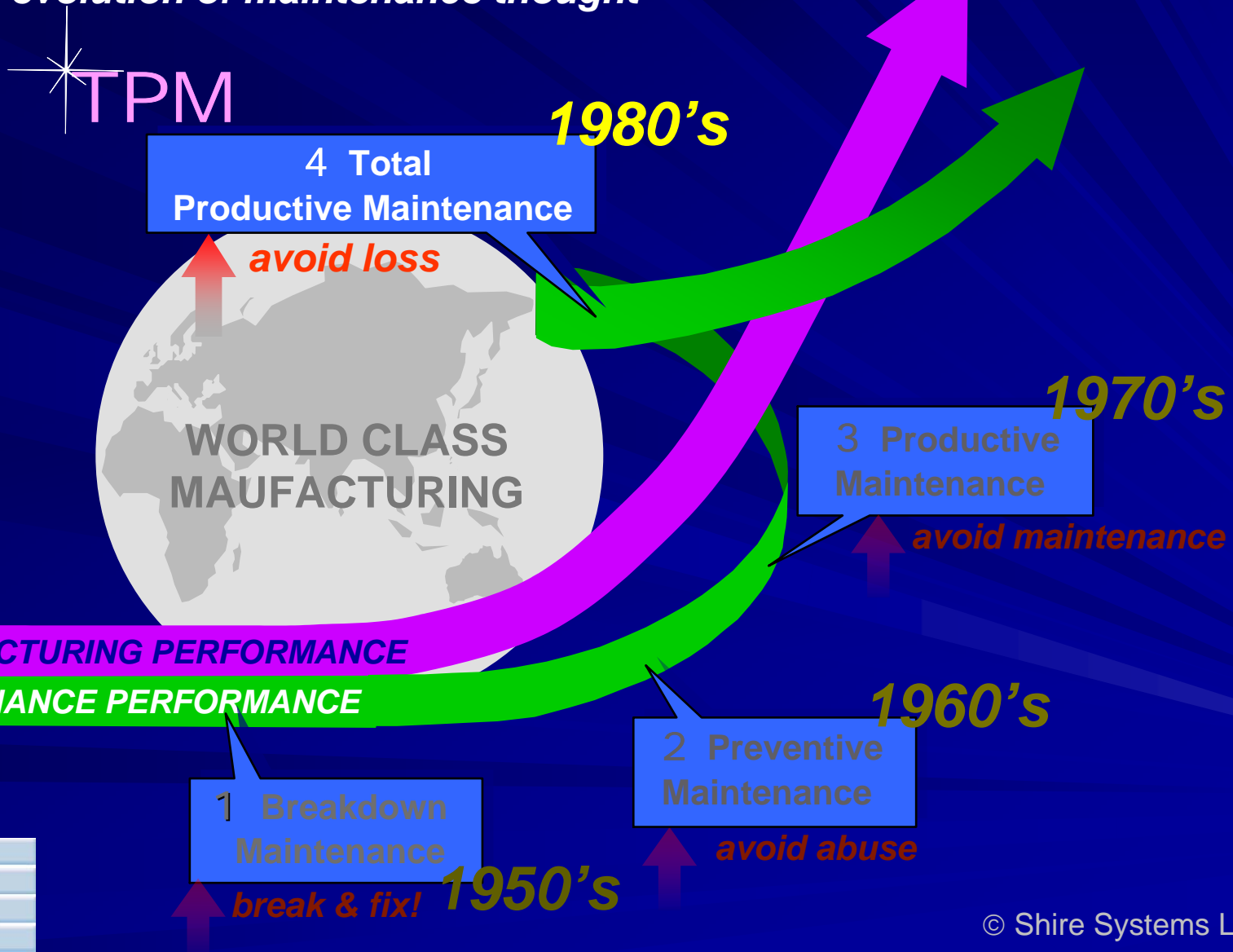
break & fix!

1950's



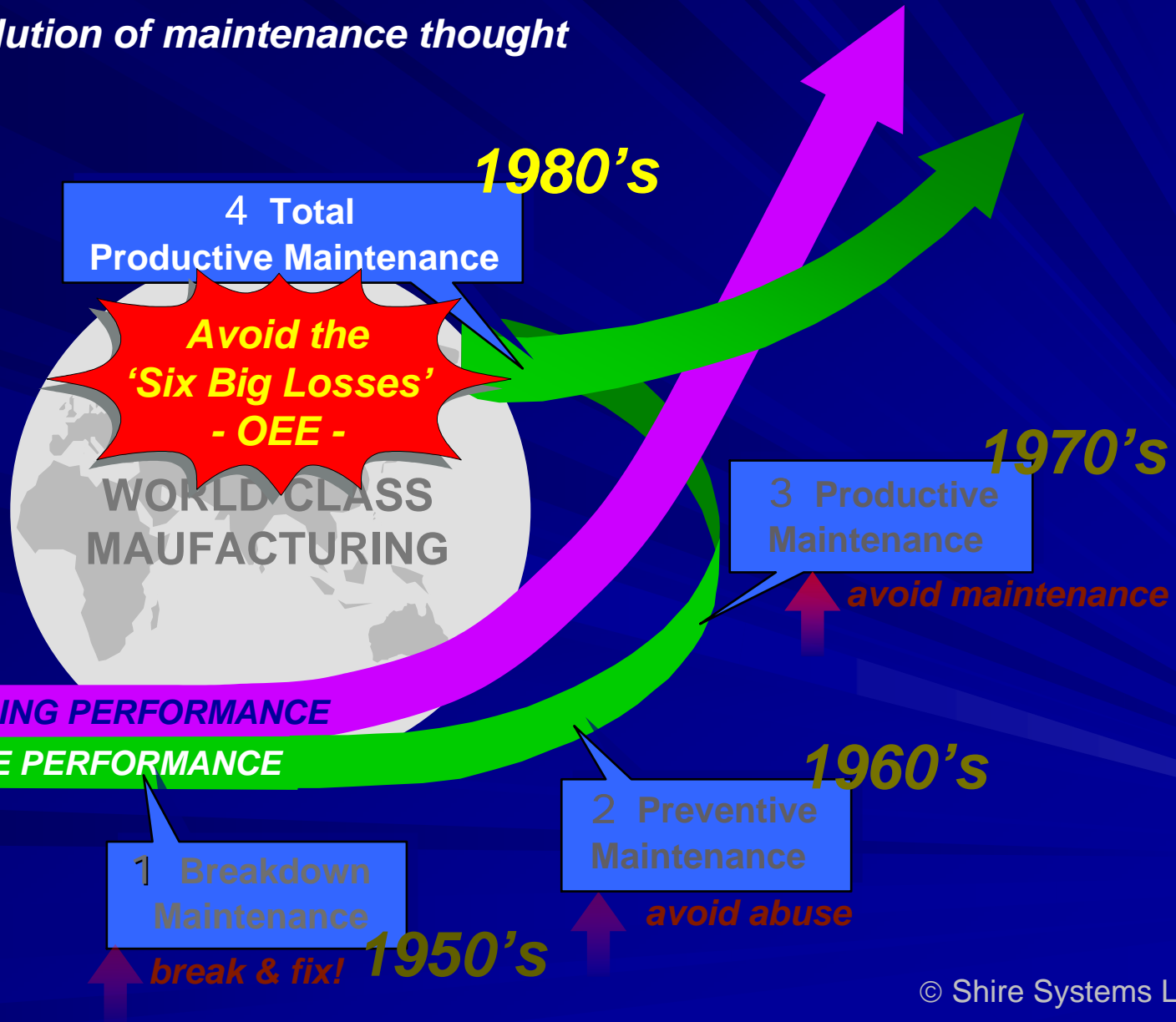
Maintenance drives manufacturing performance

- the evolution of maintenance thought



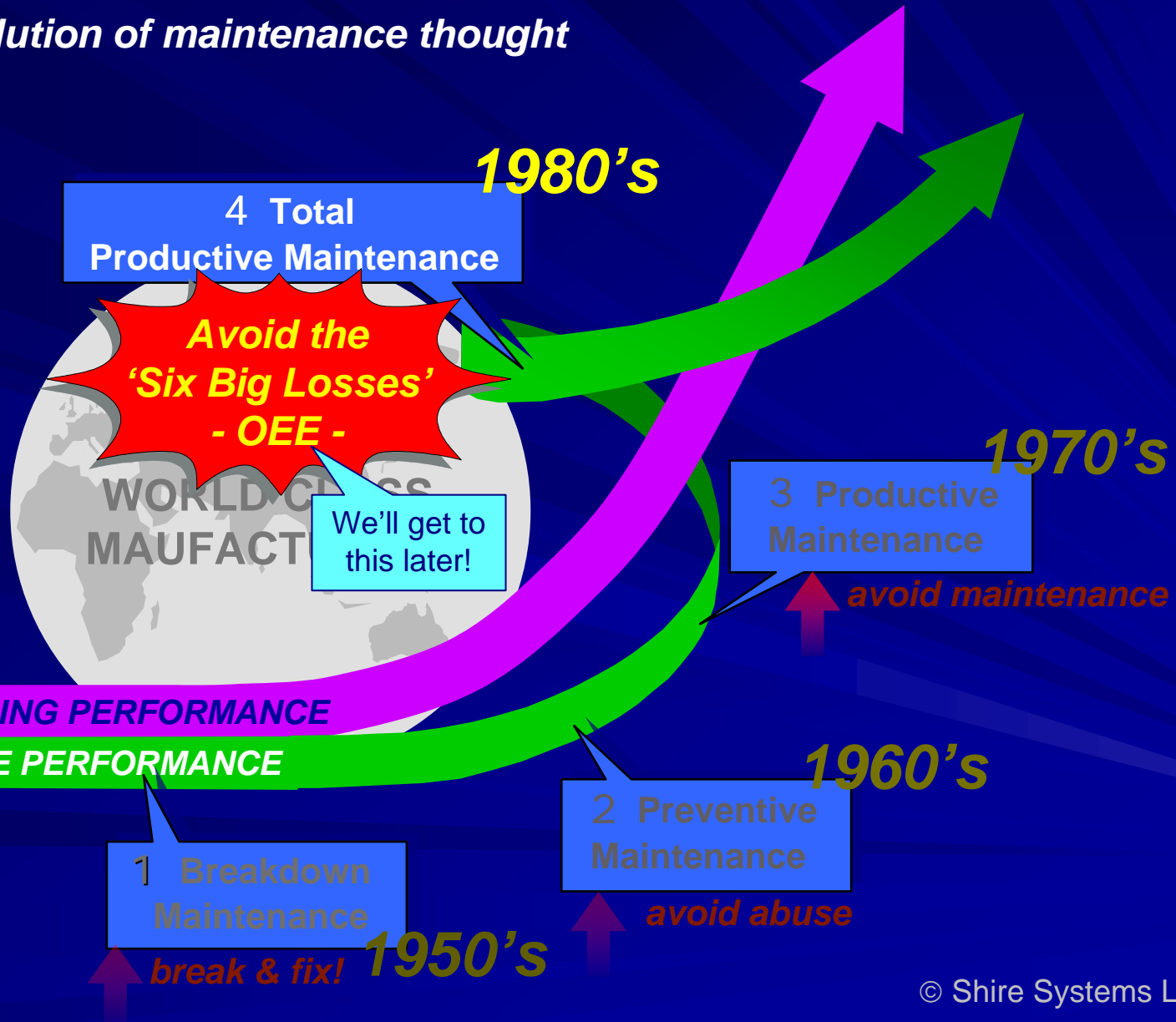
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- the evolution of maintenance thought



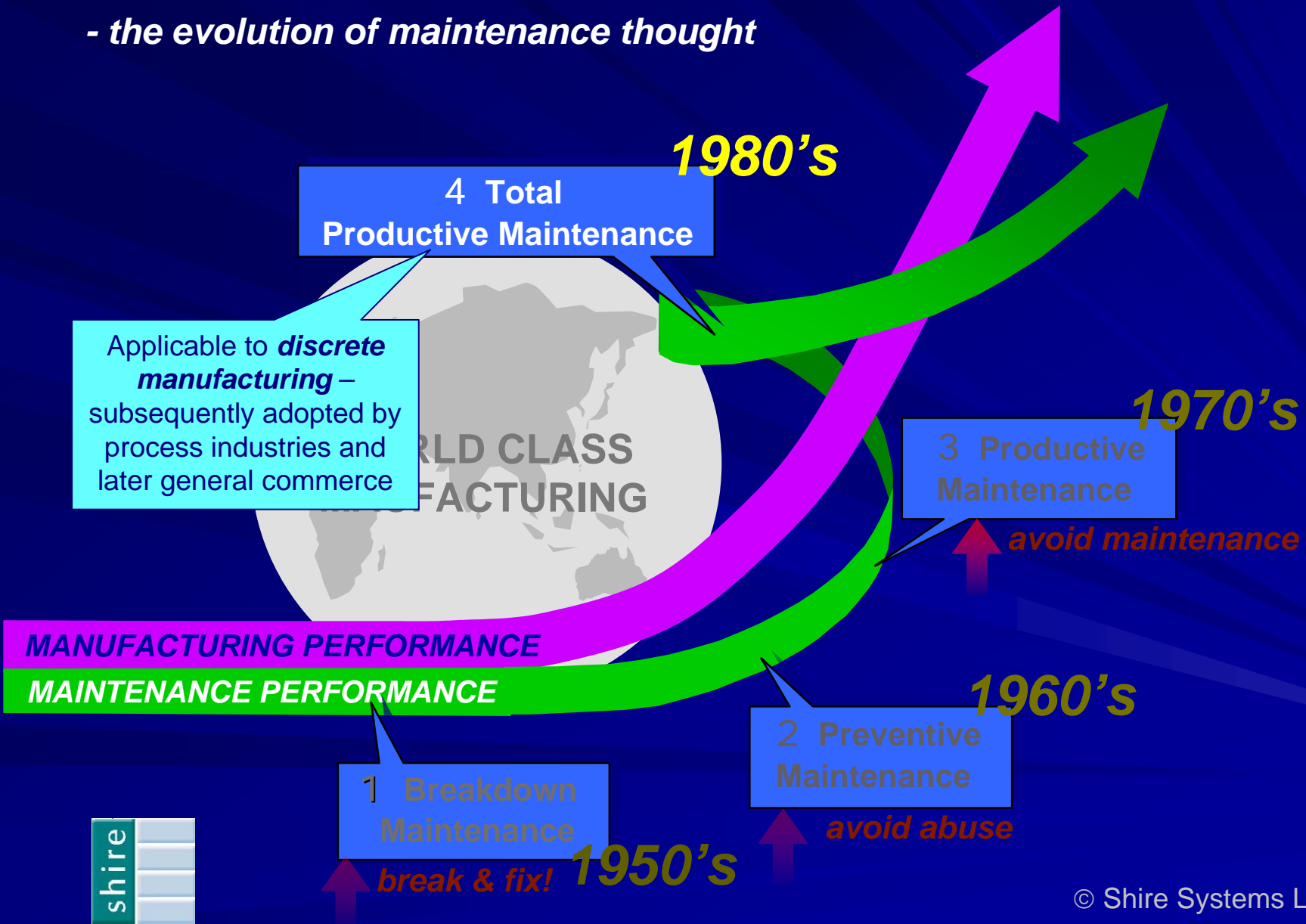
Maintenance drives manufacturing performance

- the evolution of maintenance thought



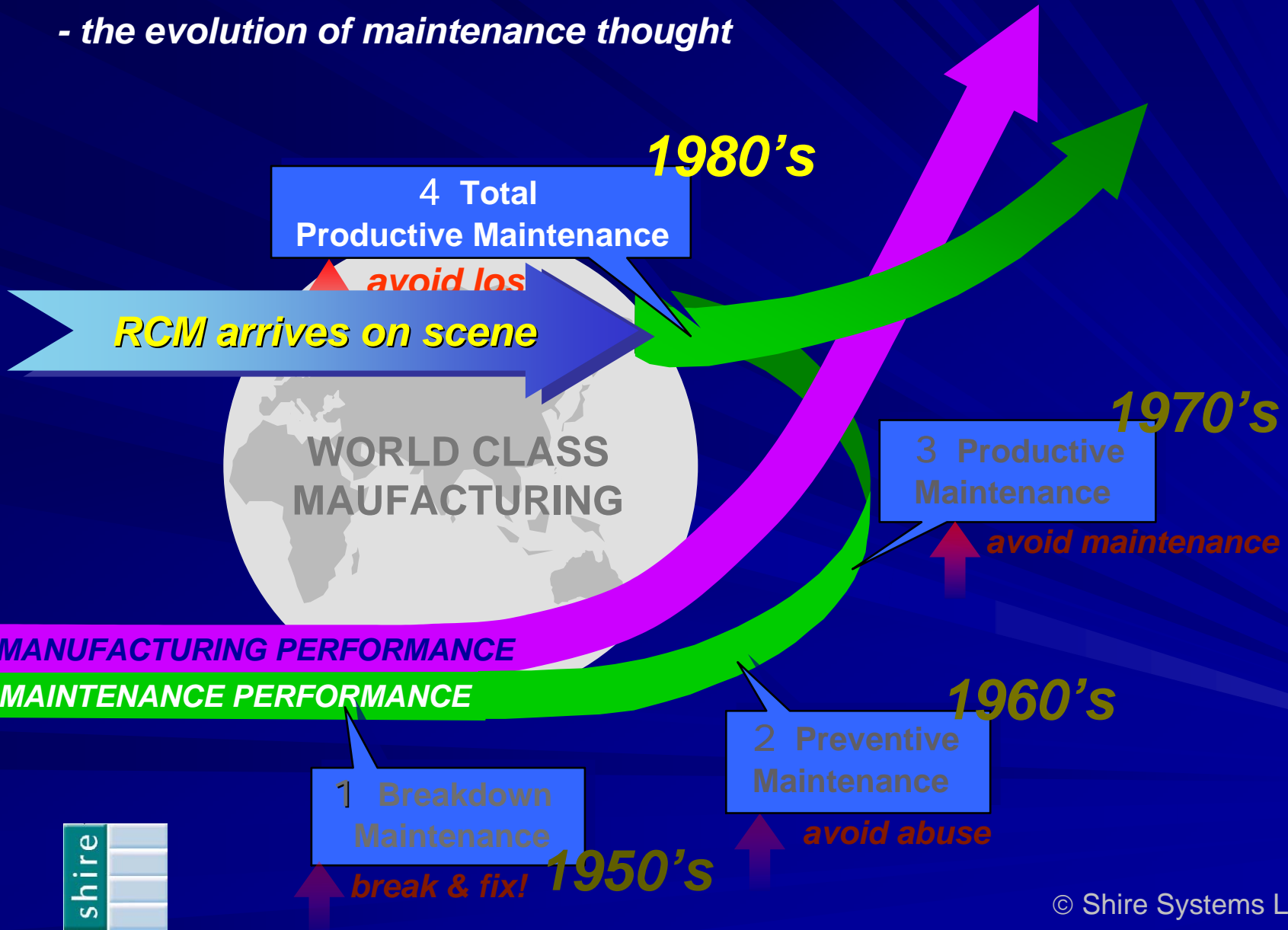
Maintenance drives manufacturing performance

- *the evolution of maintenance thought*



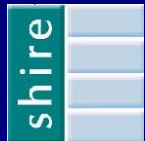
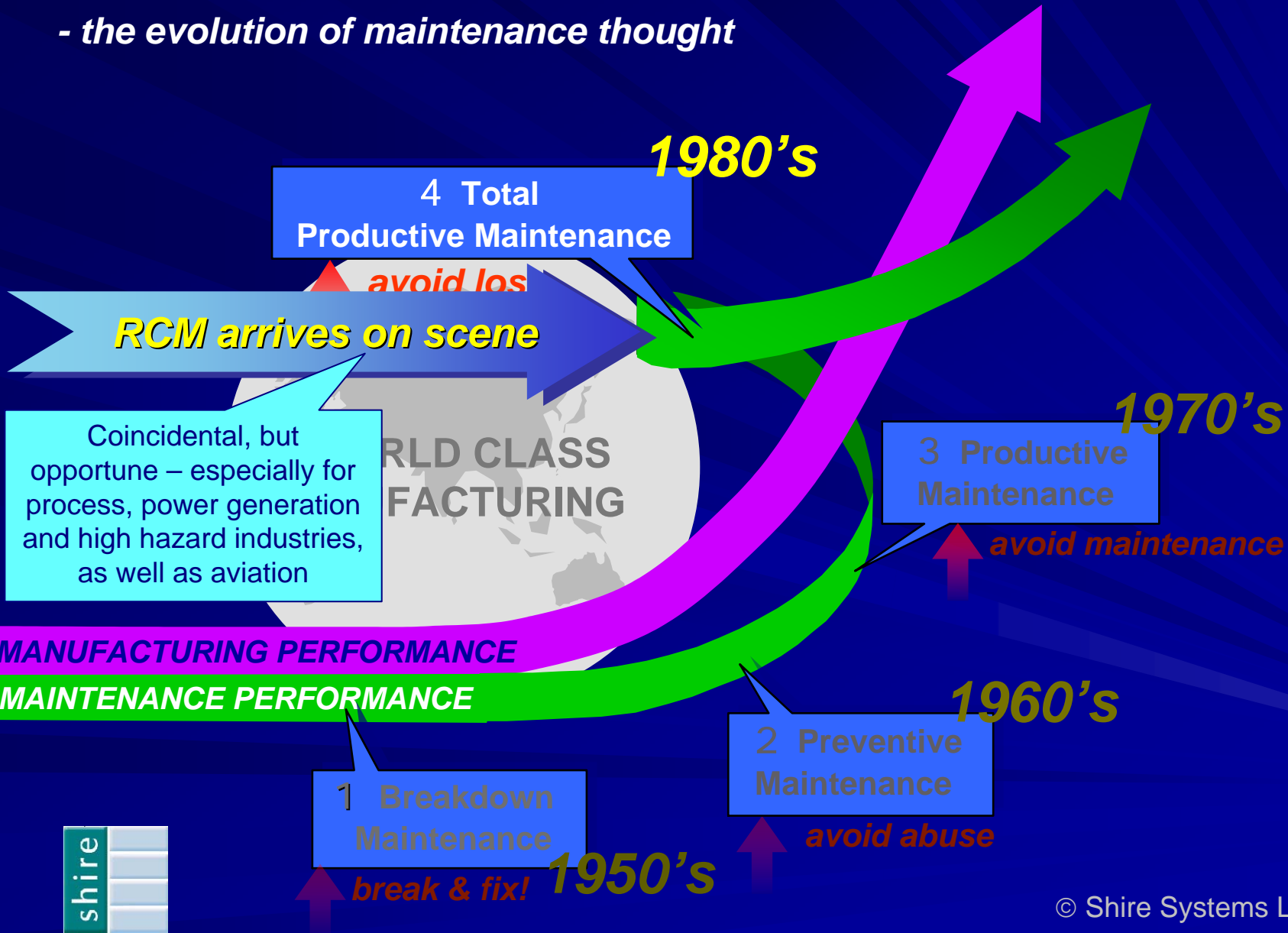
Maintenance drives manufacturing performance

- the evolution of maintenance thought



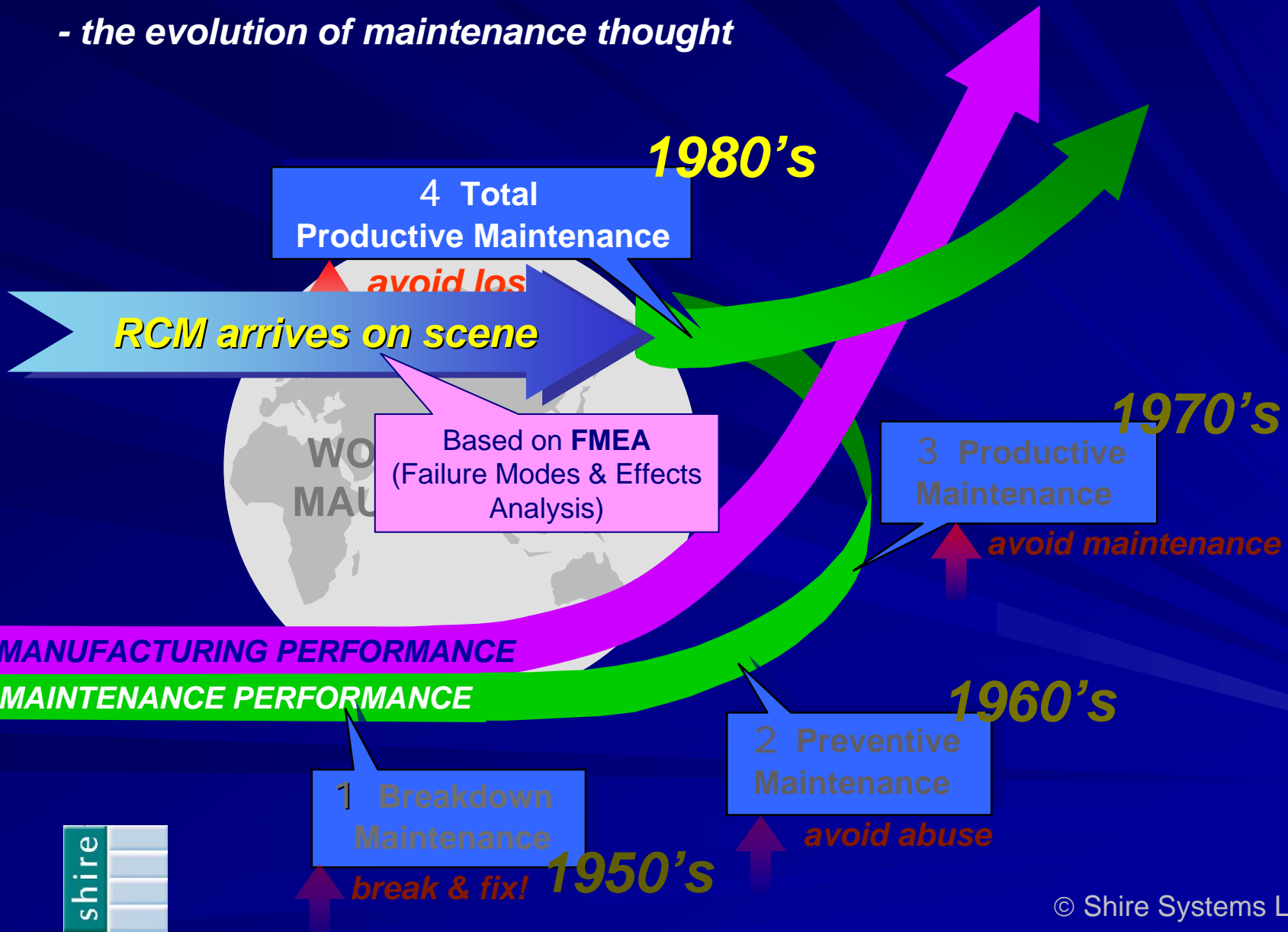
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- the evolution of maintenance thought



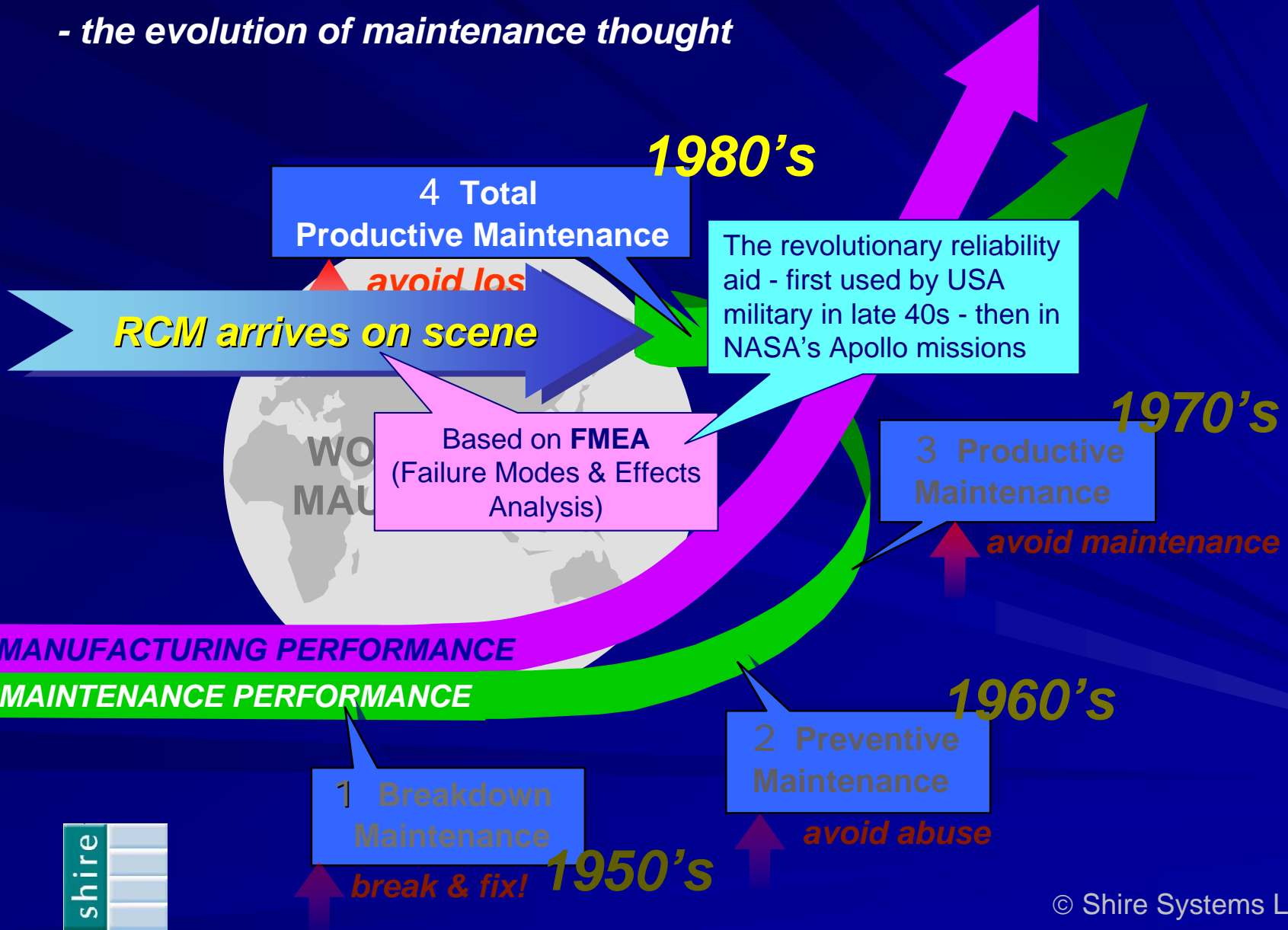
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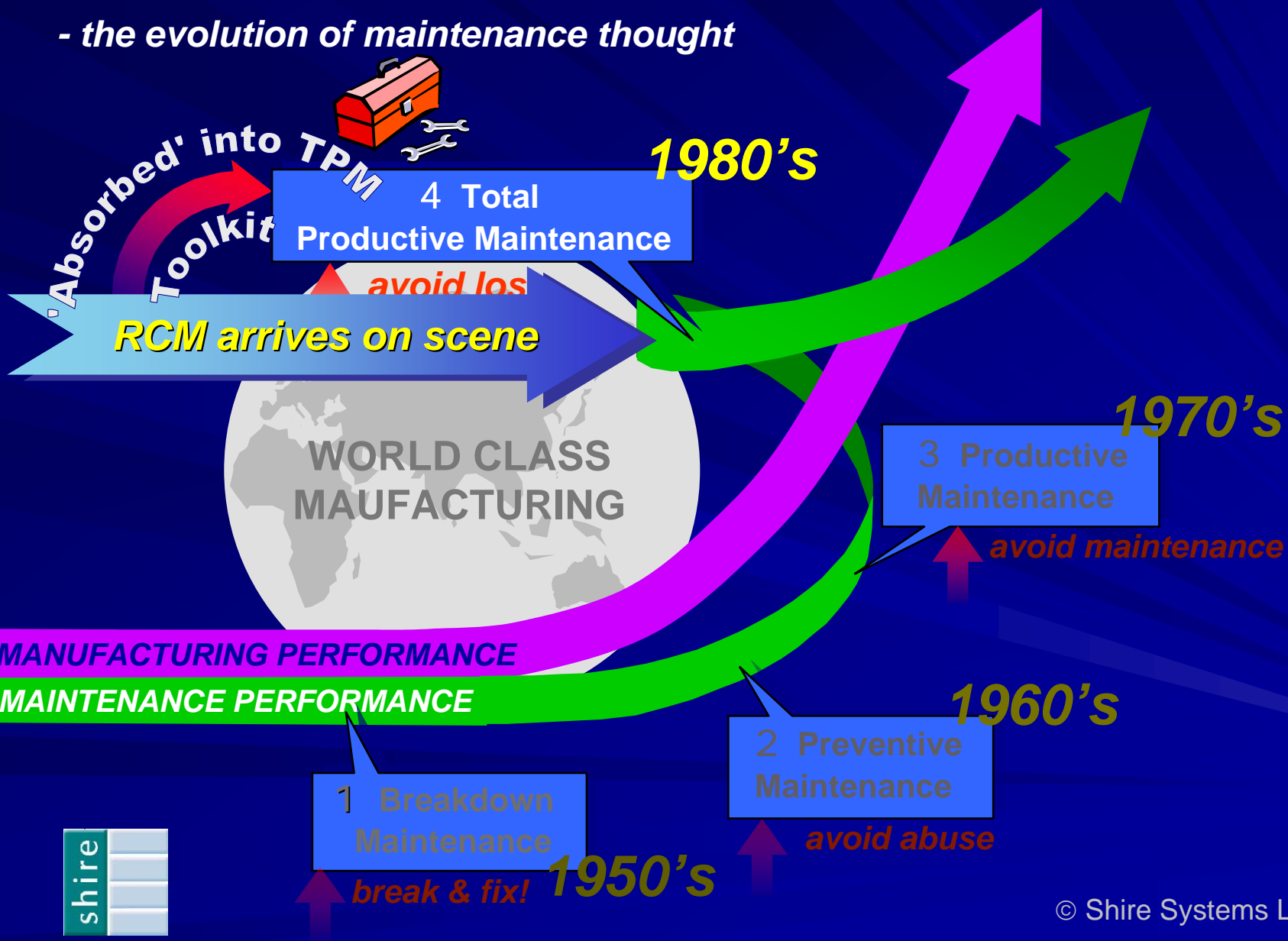
Maintenance drives manufacturing performance

- the evolution of maintenance thought



Maintenance drives manufacturing performance

- the evolution of maintenance thought



1980's
4 Total Productive Maintenance

avoid loss

RCM arrives on scene

WORLD CLASS MAUFACTURING

1970's
3 Productive Maintenance

avoid maintenance

MANUFACTURING PERFORMANCE

MAINTENANCE PERFORMANCE

1950's
1 Breakdown Maintenance

break & fix!

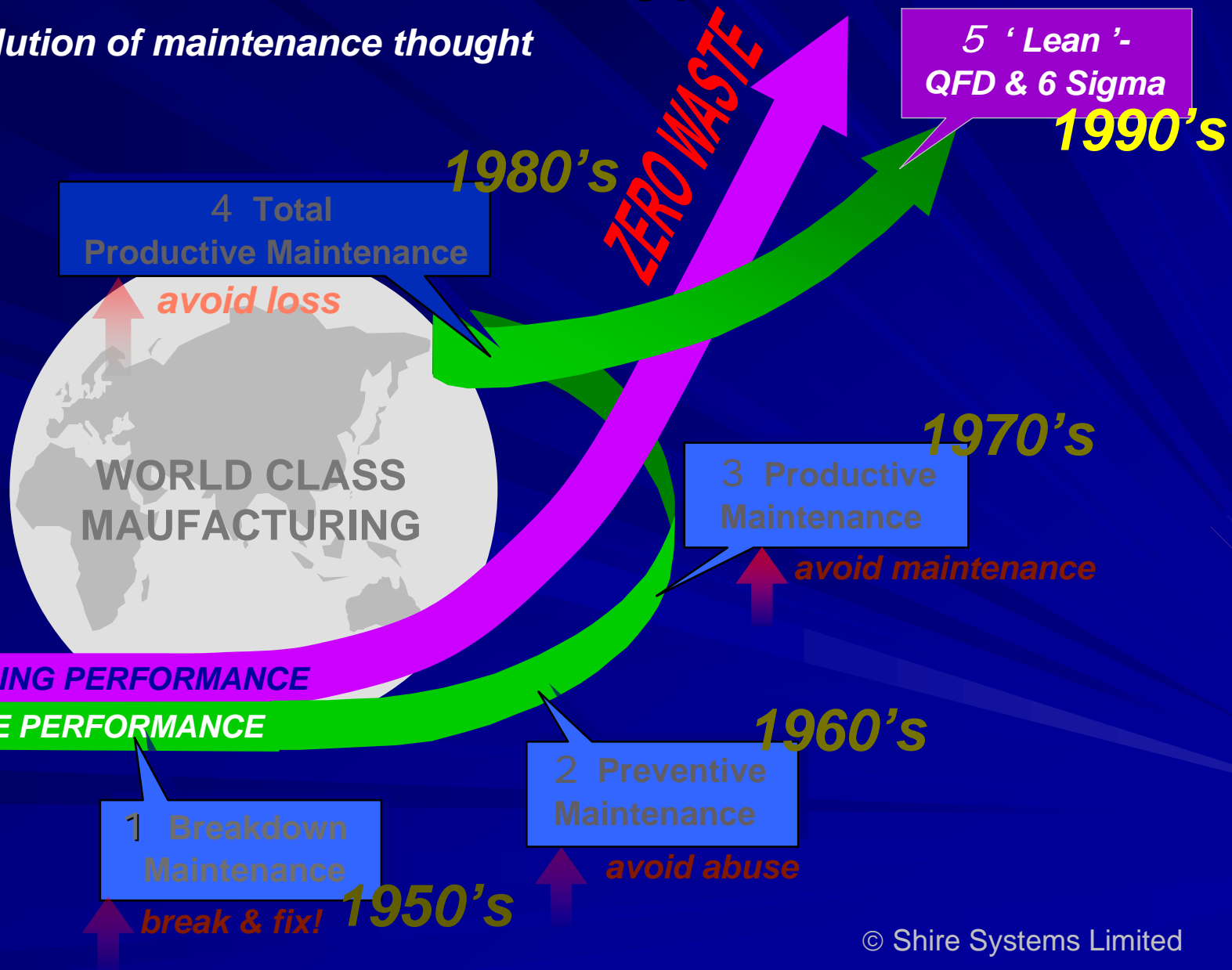
1960's
2 Preventive Maintenance

avoid abuse



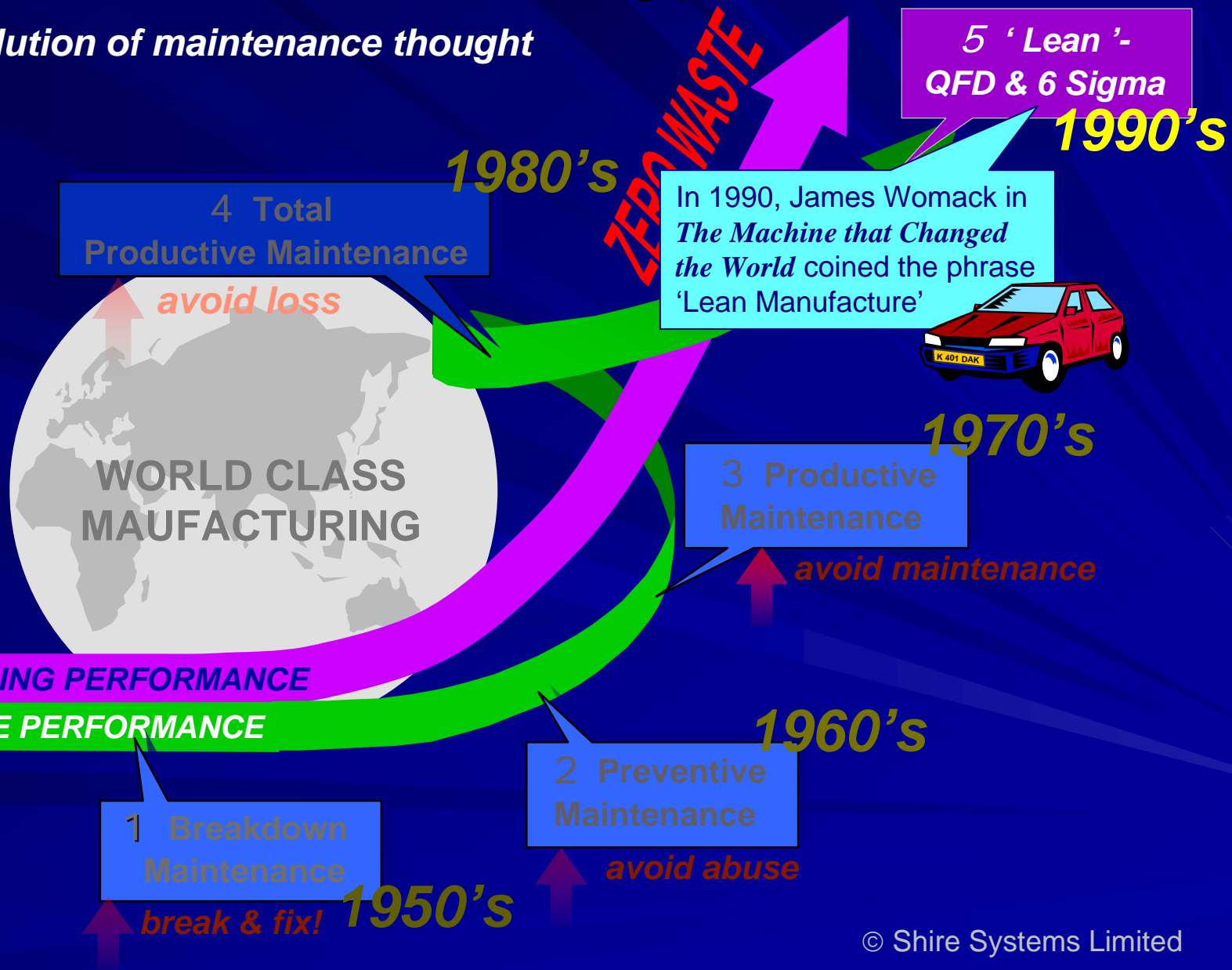
Maintenance drives manufacturing performance

- the evolution of maintenance thought



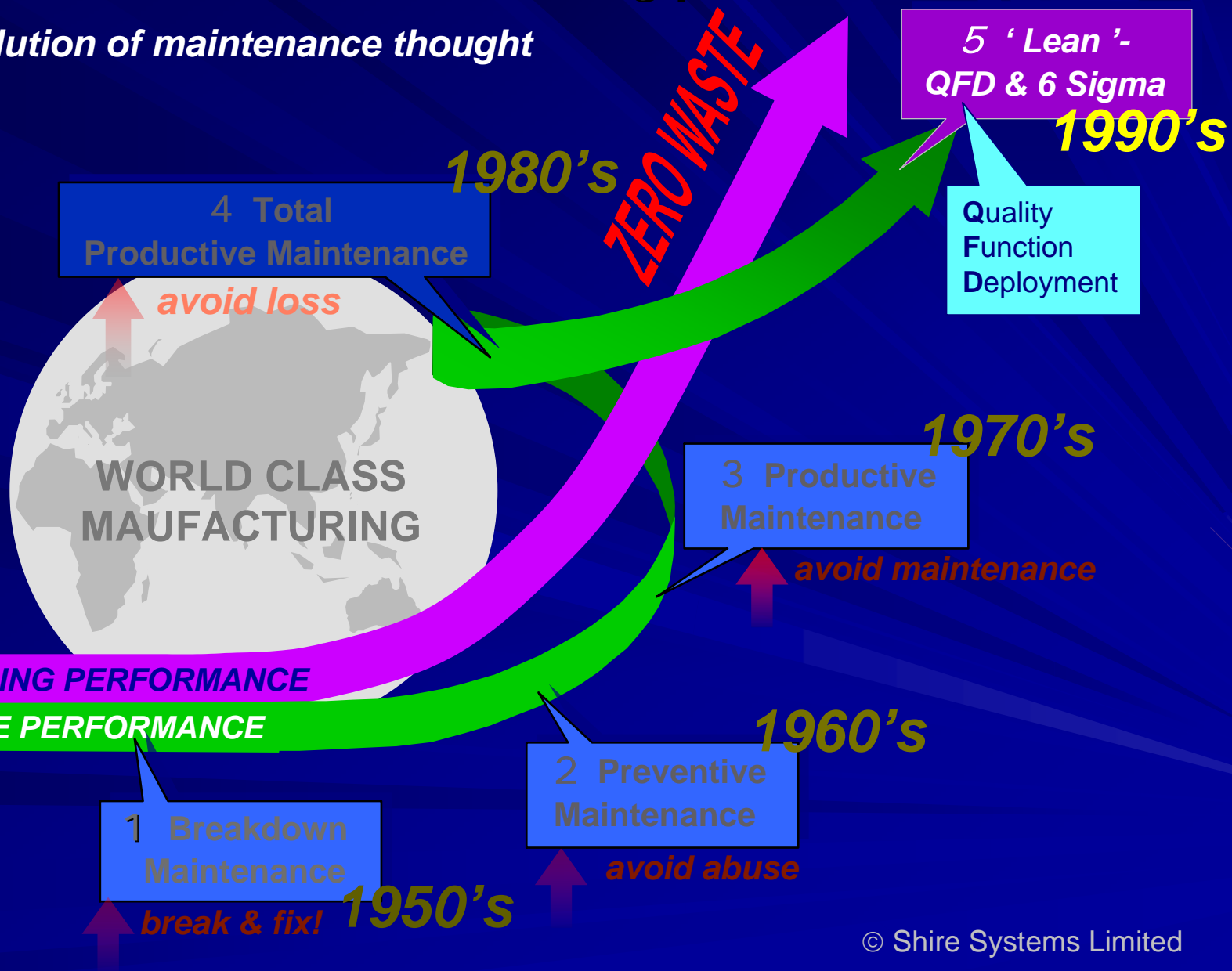
Maintenance drives manufacturing performance

- the evolution of maintenance thought



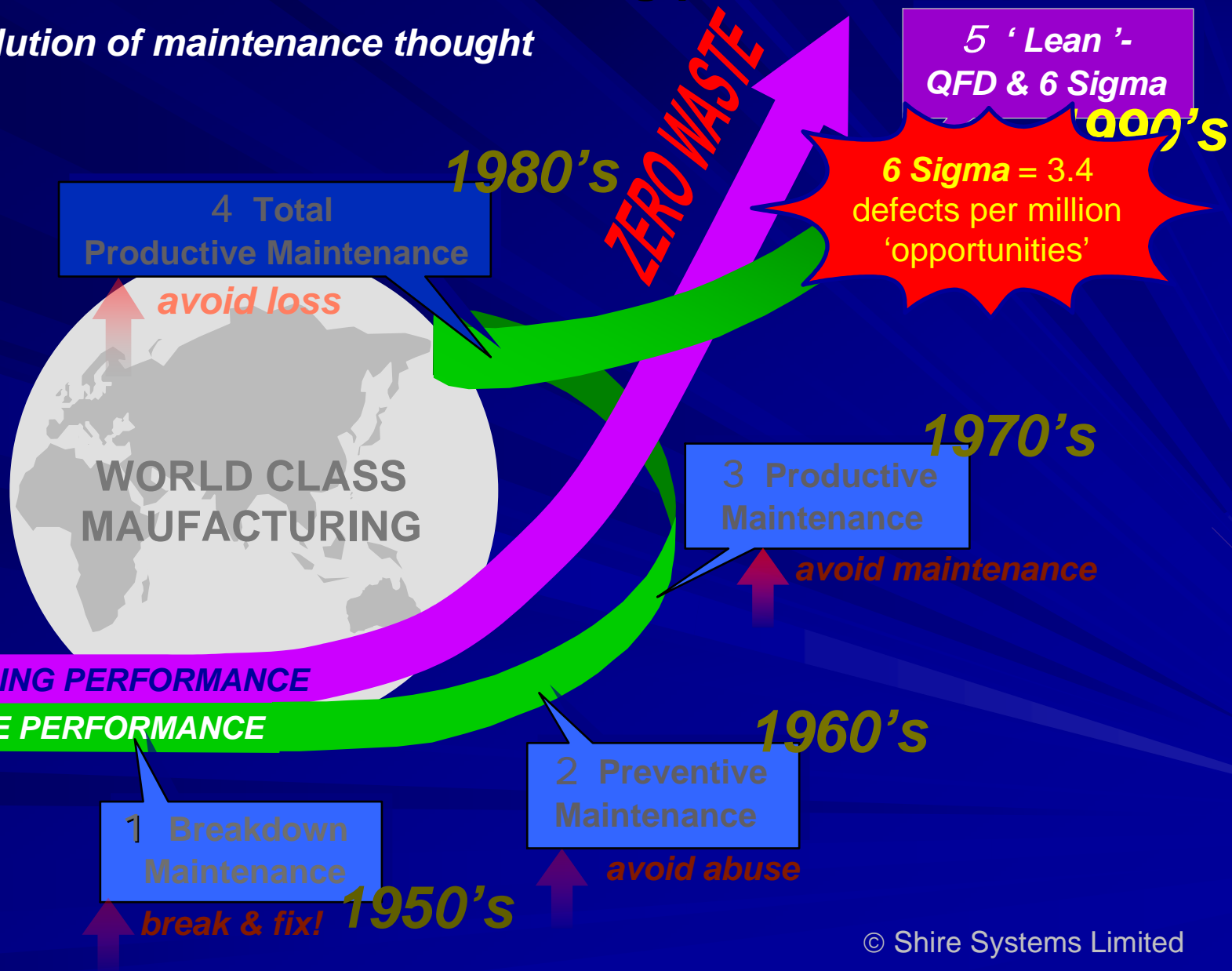
Maintenance drives manufacturing performance

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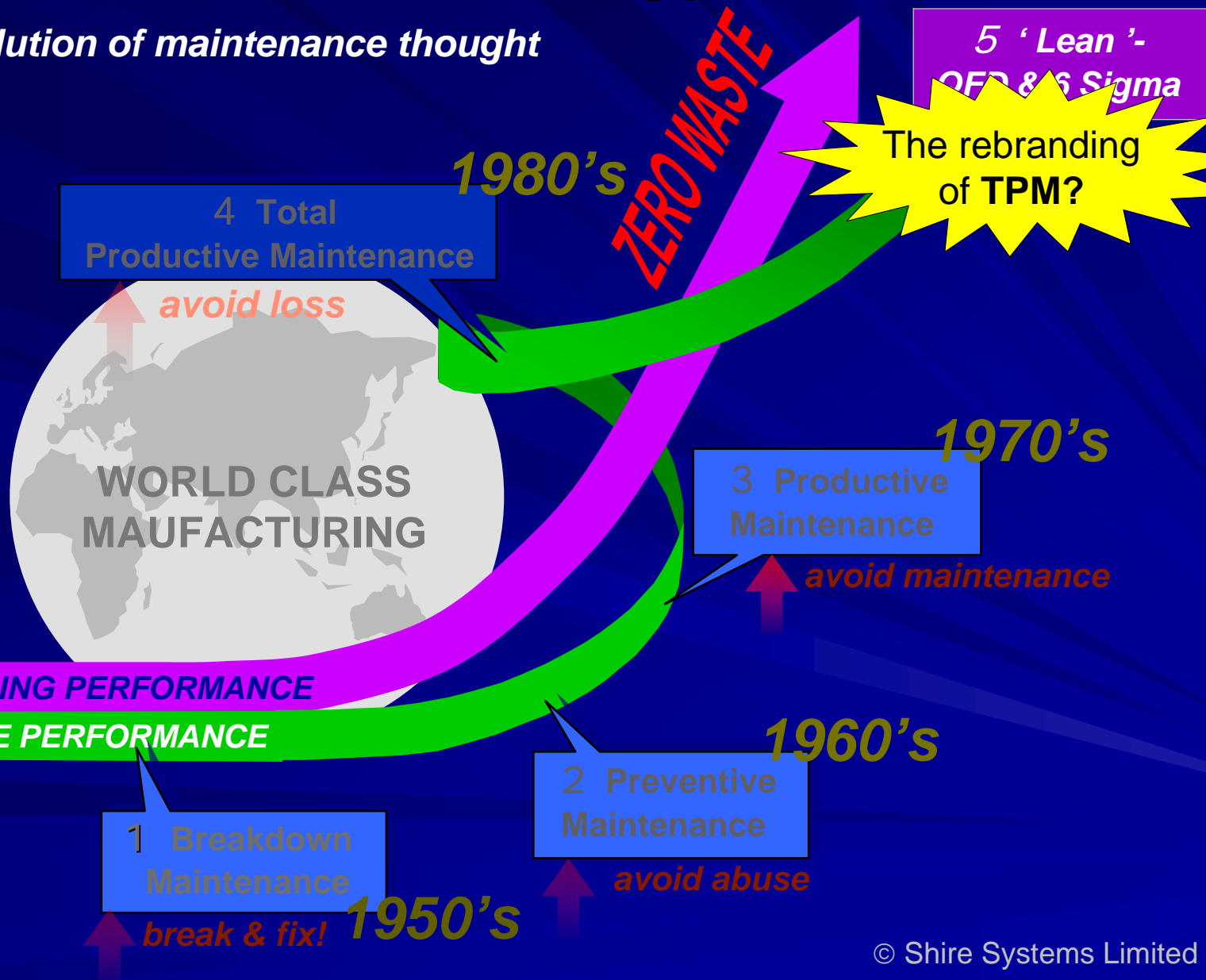
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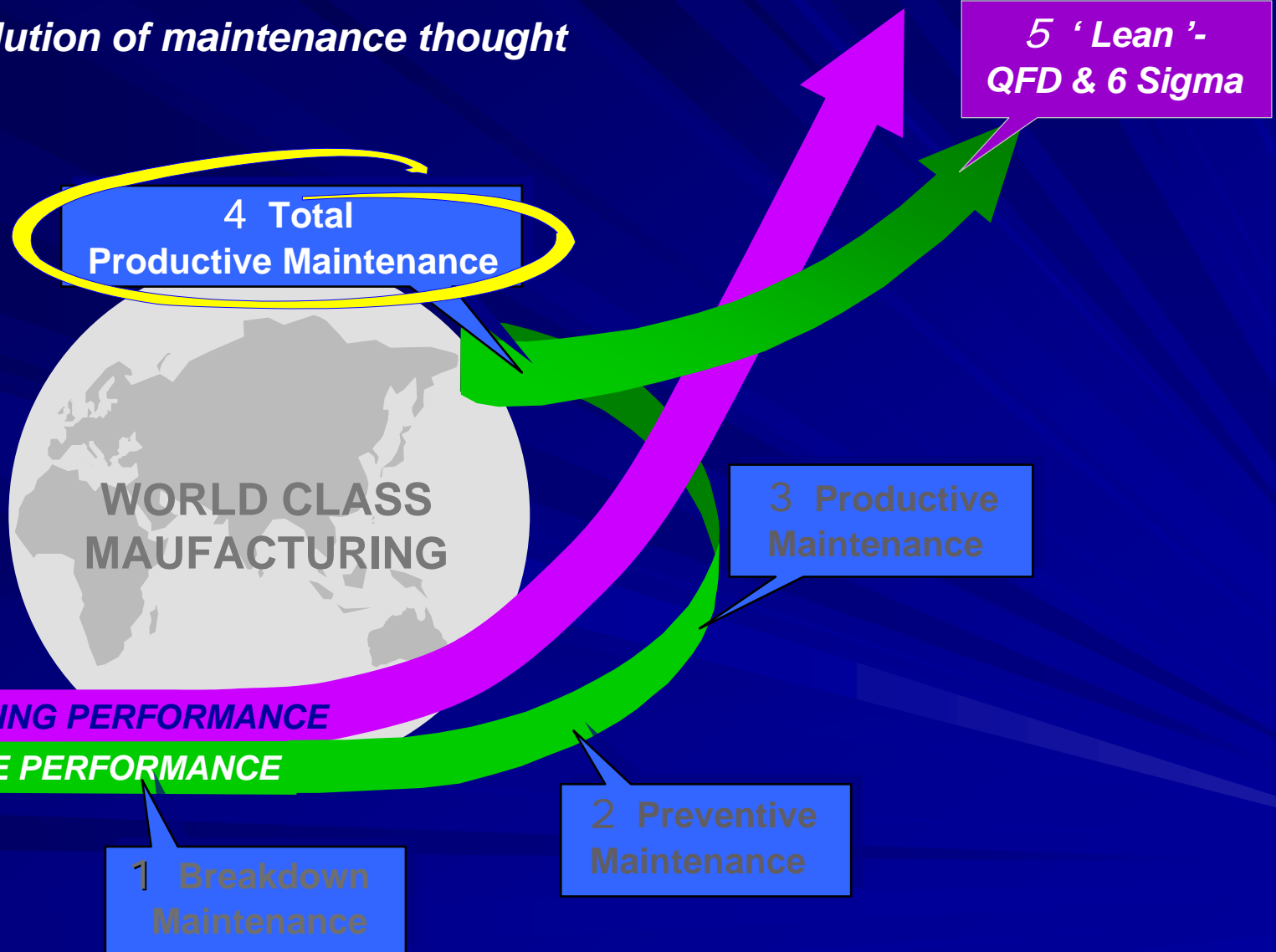
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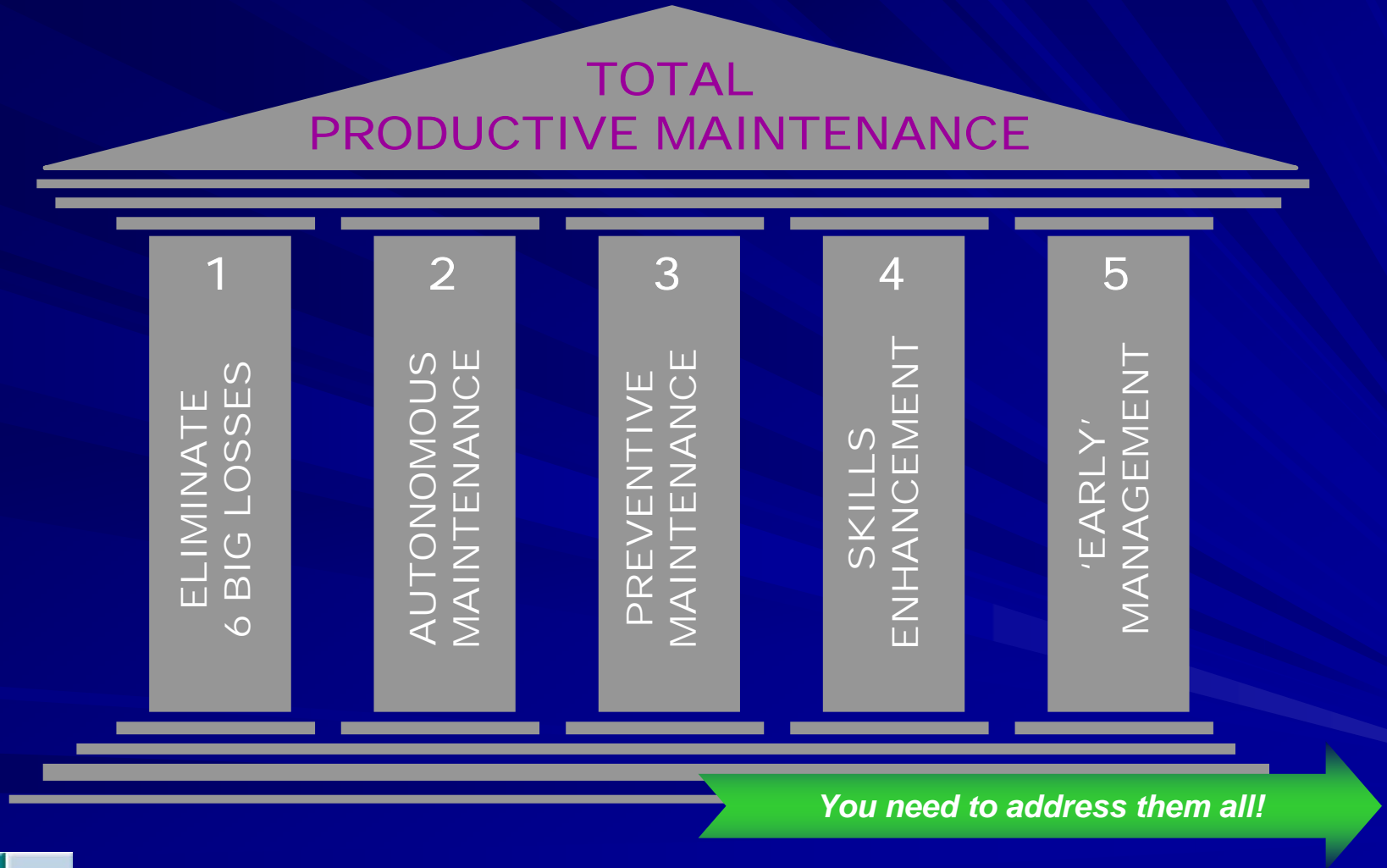
- the evolution of maintenance thought



TPM – the ‘5 Pillars’



TPM - the basic '5 pillars'



TPM - the basic '5 pillars'

Ref: Nakajima, 1984

TOTAL
PRODUCTIVE MAINTENANCE

JIPM (Japan Institute of
Plant Maintenance)

1

ELIMINATE
6 BIG LOSSES

2

AUTONOMOUS
MAINTENANCE

3

PREVENTIVE
MAINTENANCE

4

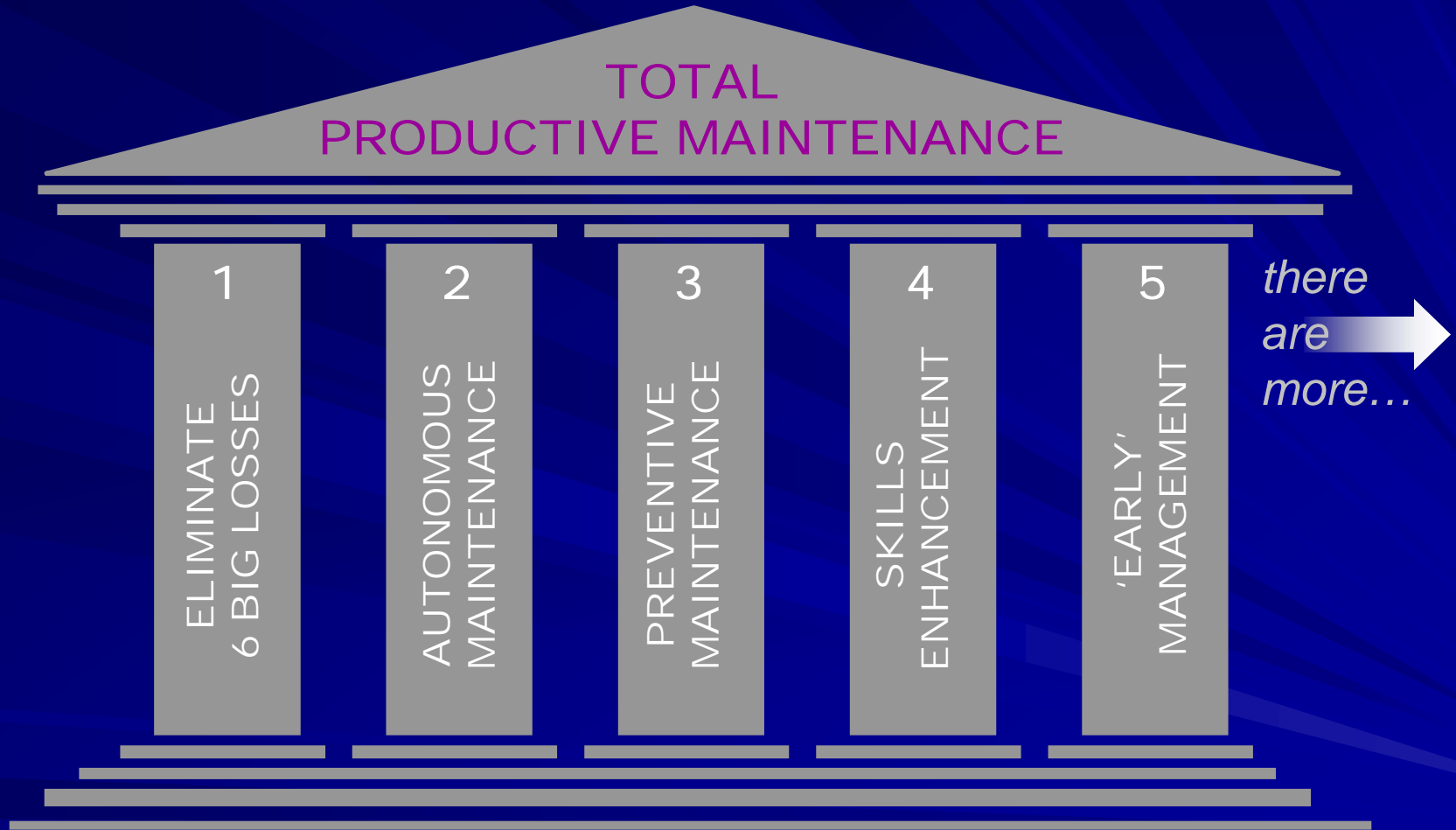
SKILLS
ENHANCEMENT

5

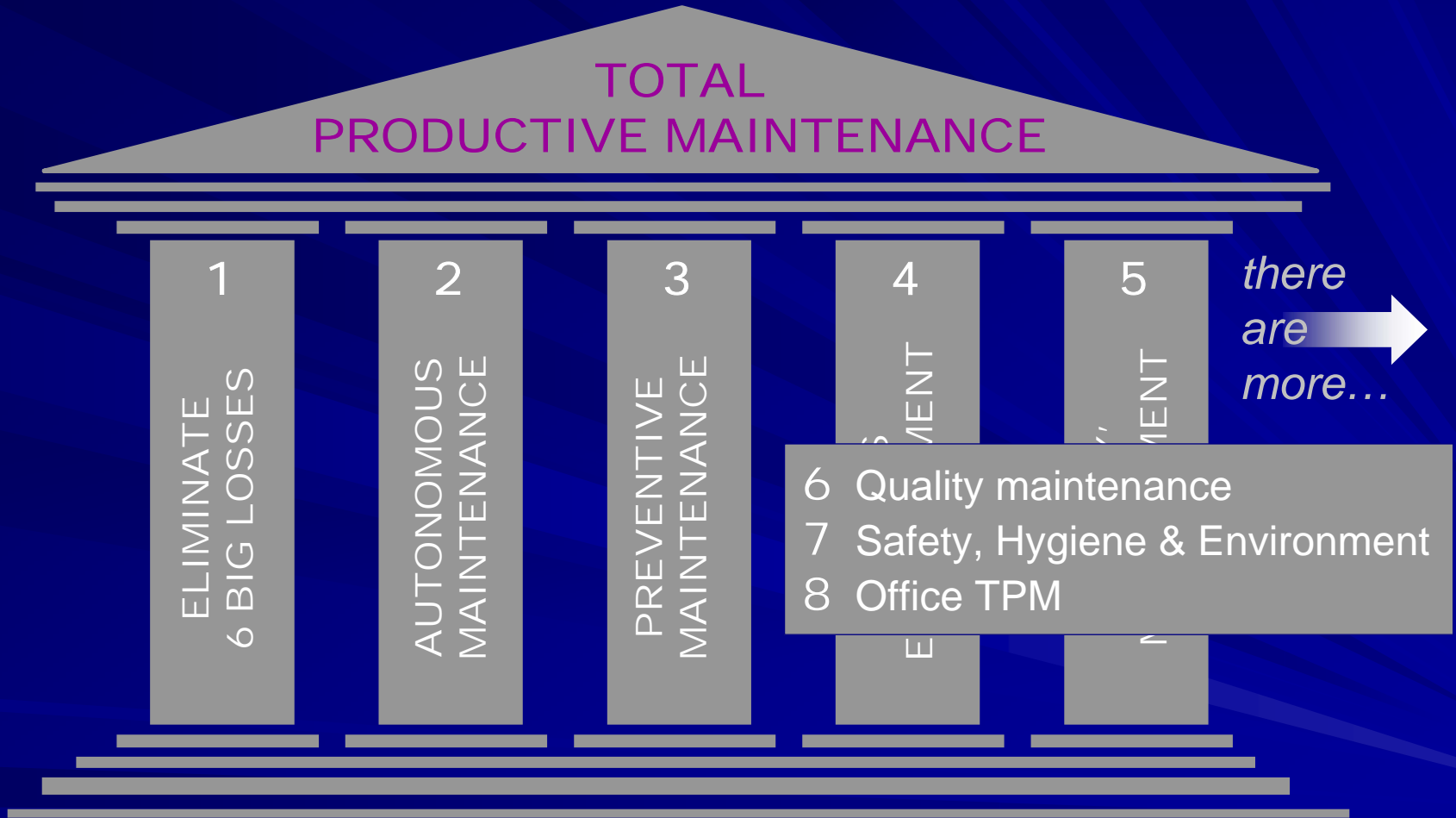
'EARLY'
MANAGEMENT

You need to address them all!

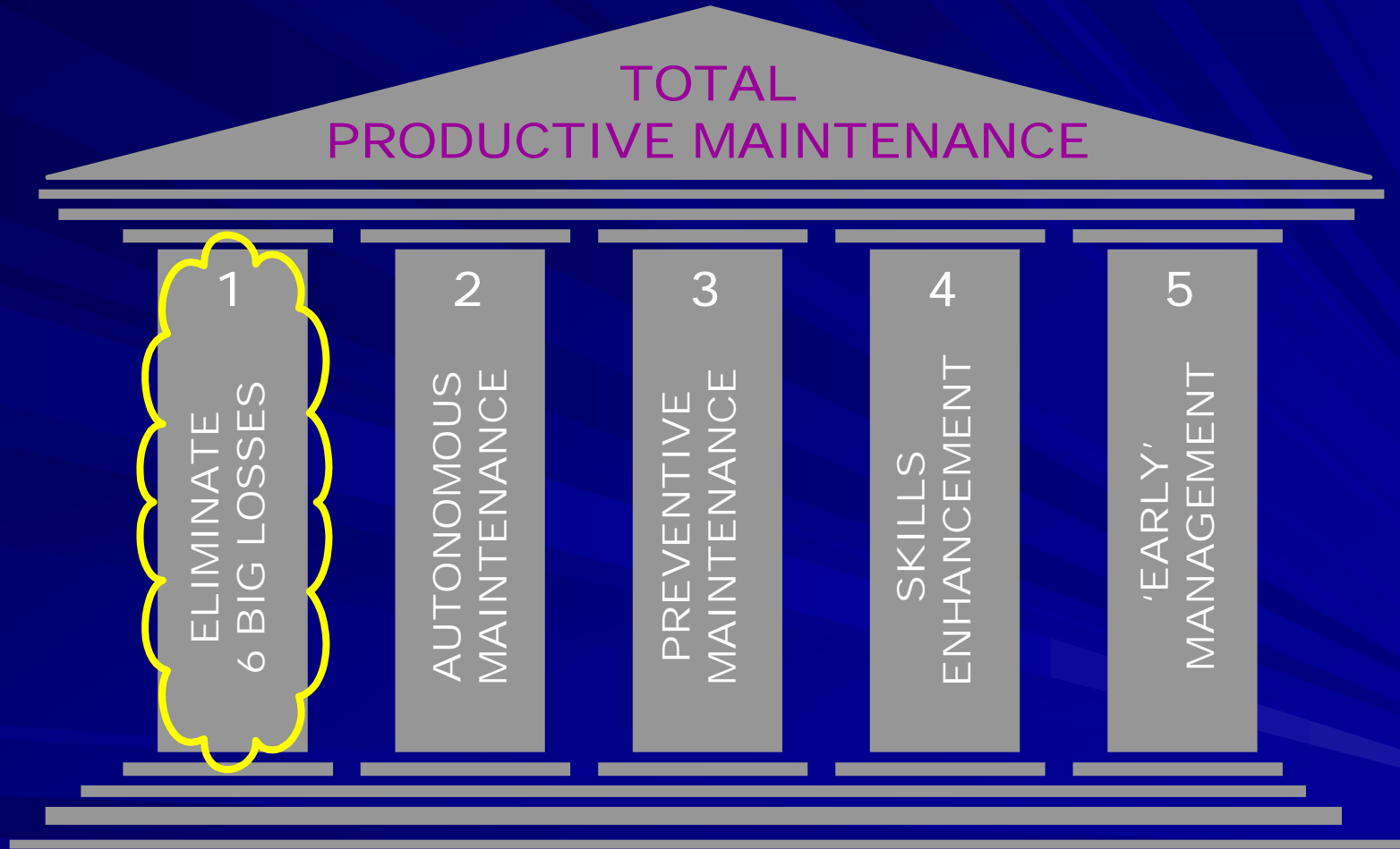
TPM - the basic '5 pillars'



TPM - the basic '5 pillars'



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TPM - the basic '5 pillars'

The 6 BIG Losses

1
Equipment
Failure/Shutdown

2
Production Setup &
Adjustment

3
Idling &
Minor Stoppages

4
Reduced Speed

5
Defects in Production

6
Reduced Yield

TOTAL PRODUCTIVE MAINTENANCE

3

PREVENTIVE
MAINTENANCE

4

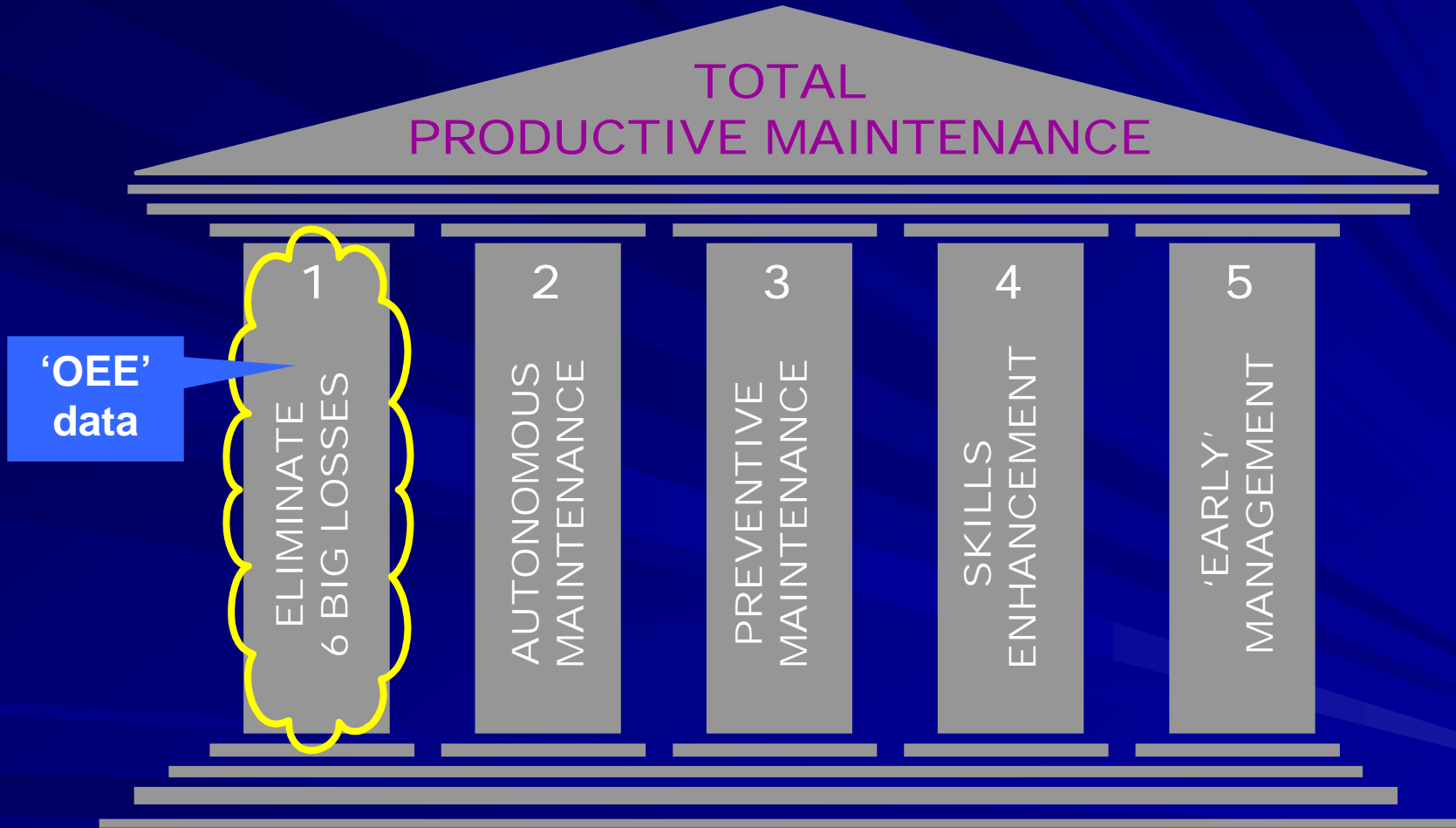
SKILLS
ENHANCEMENT

5

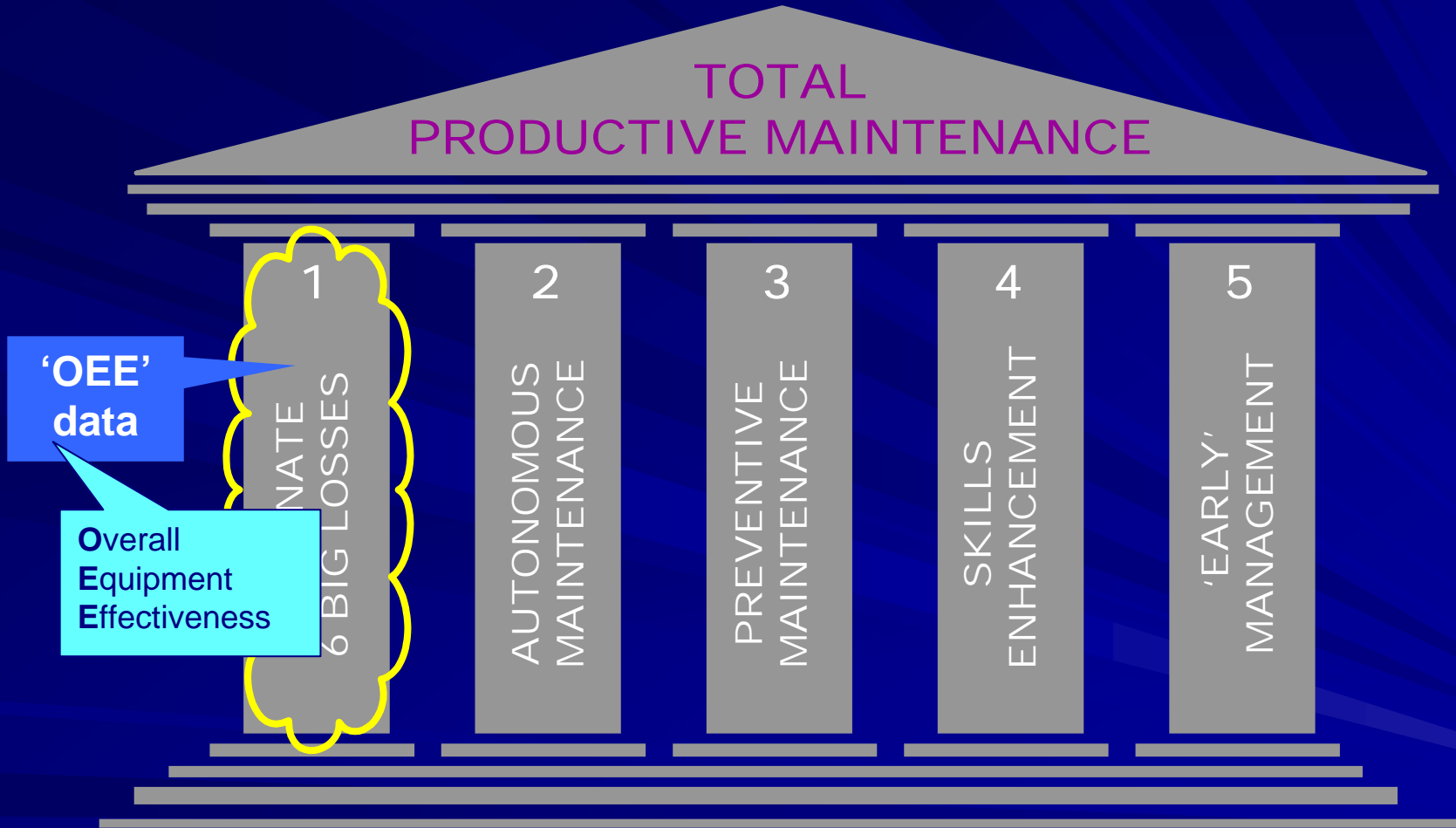
'EARLY'
MANAGEMENT

Data is collected
on each 'loss' ...

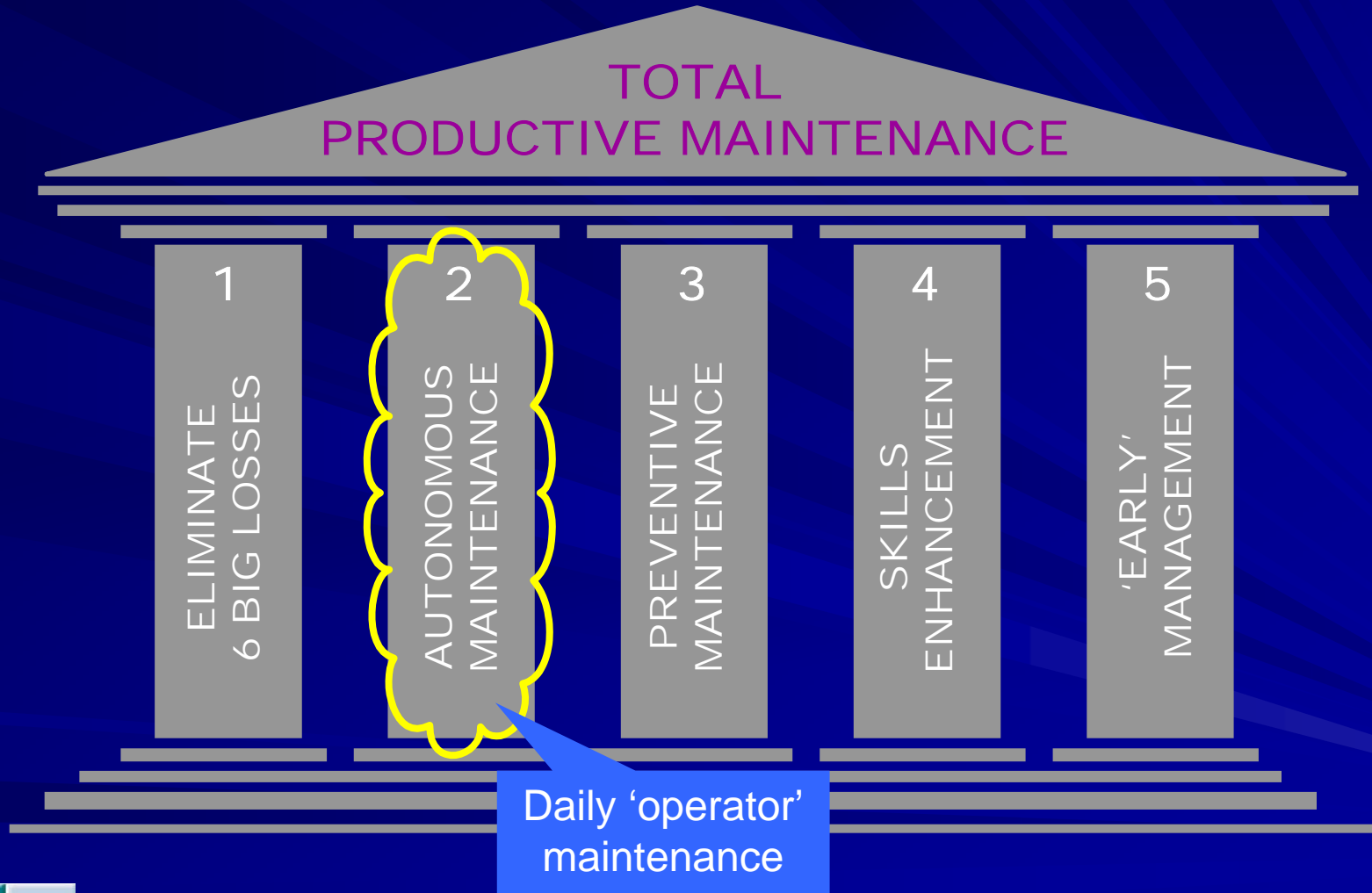
TPM - the basic '5 pillars'



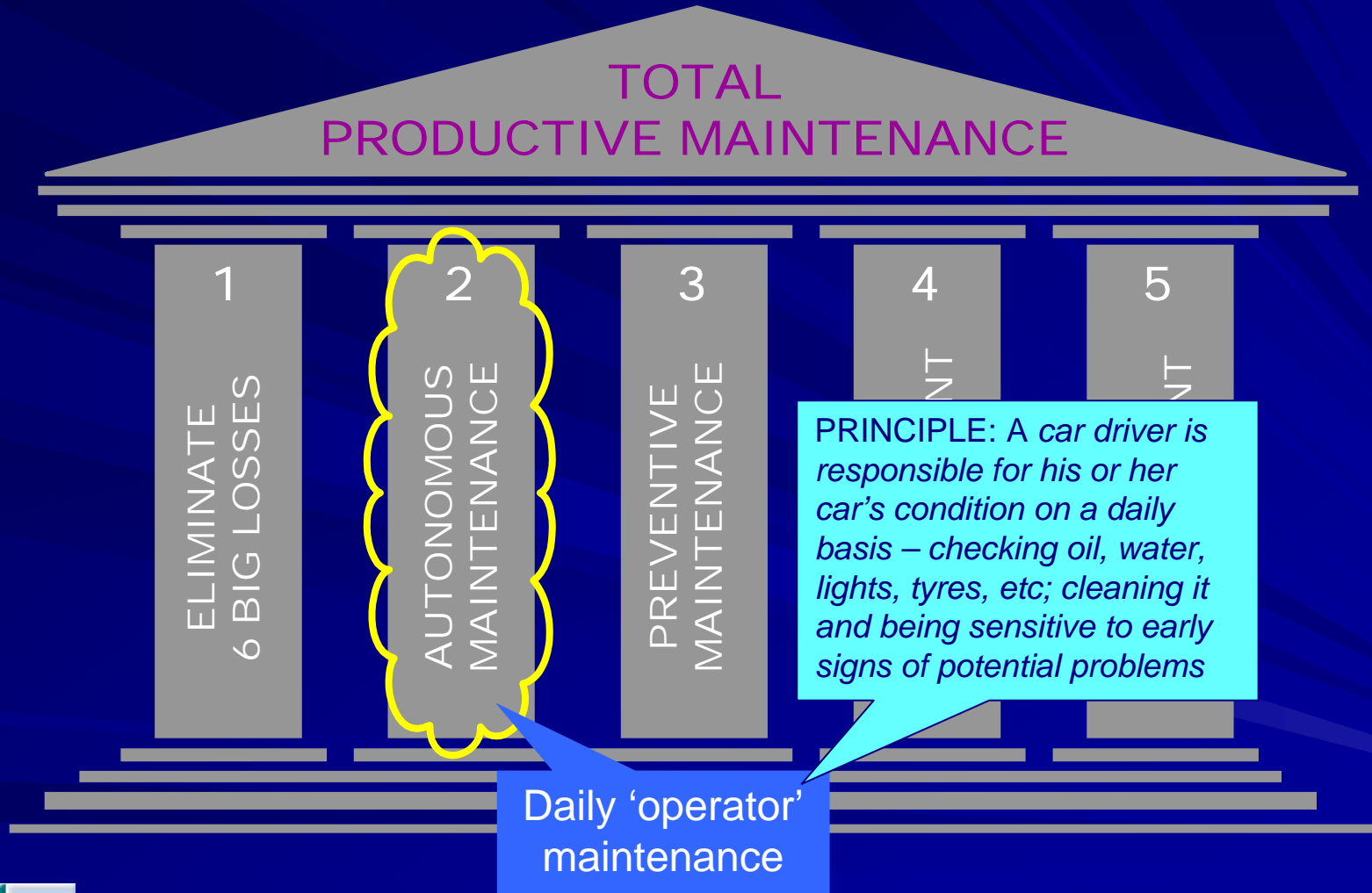
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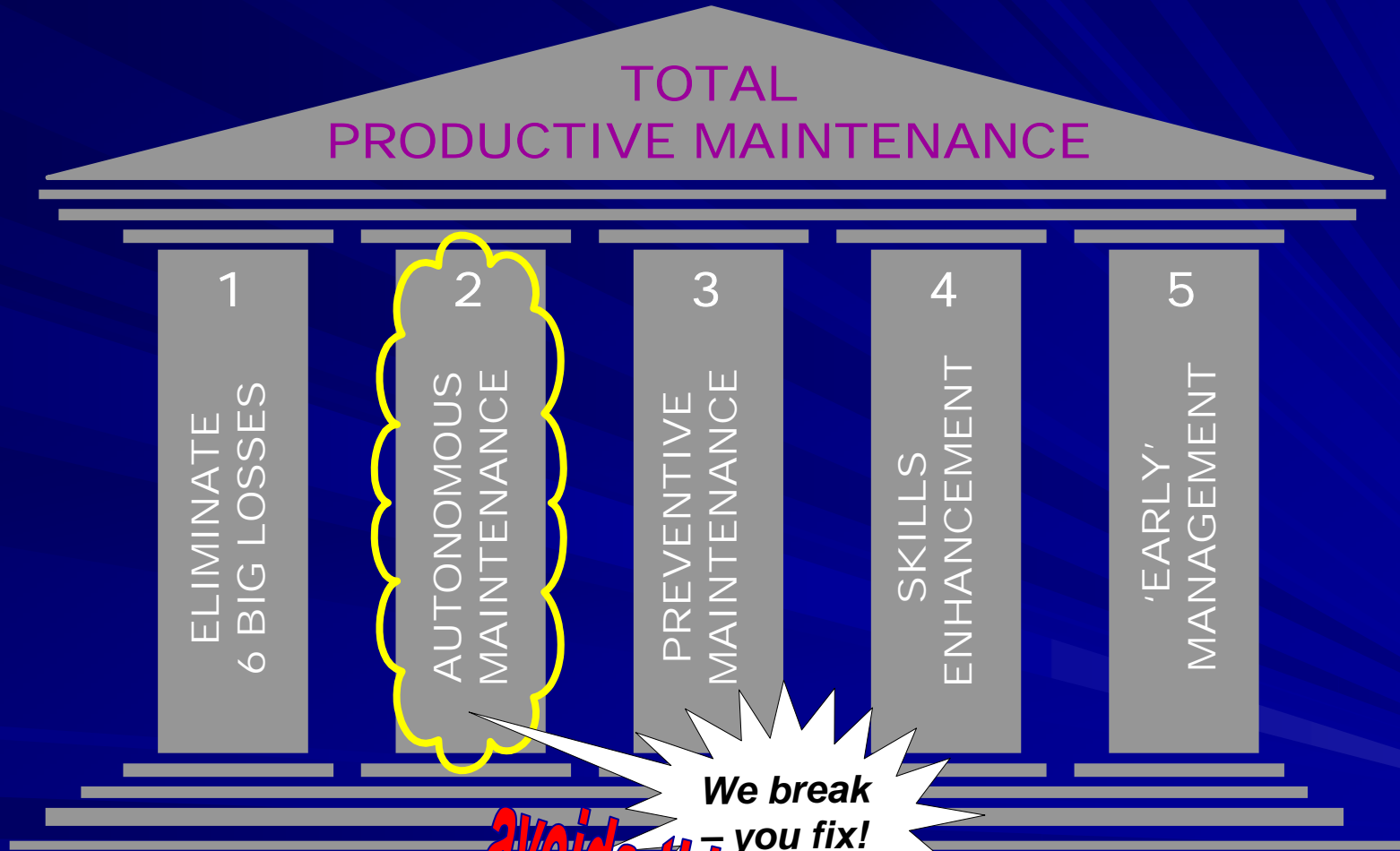
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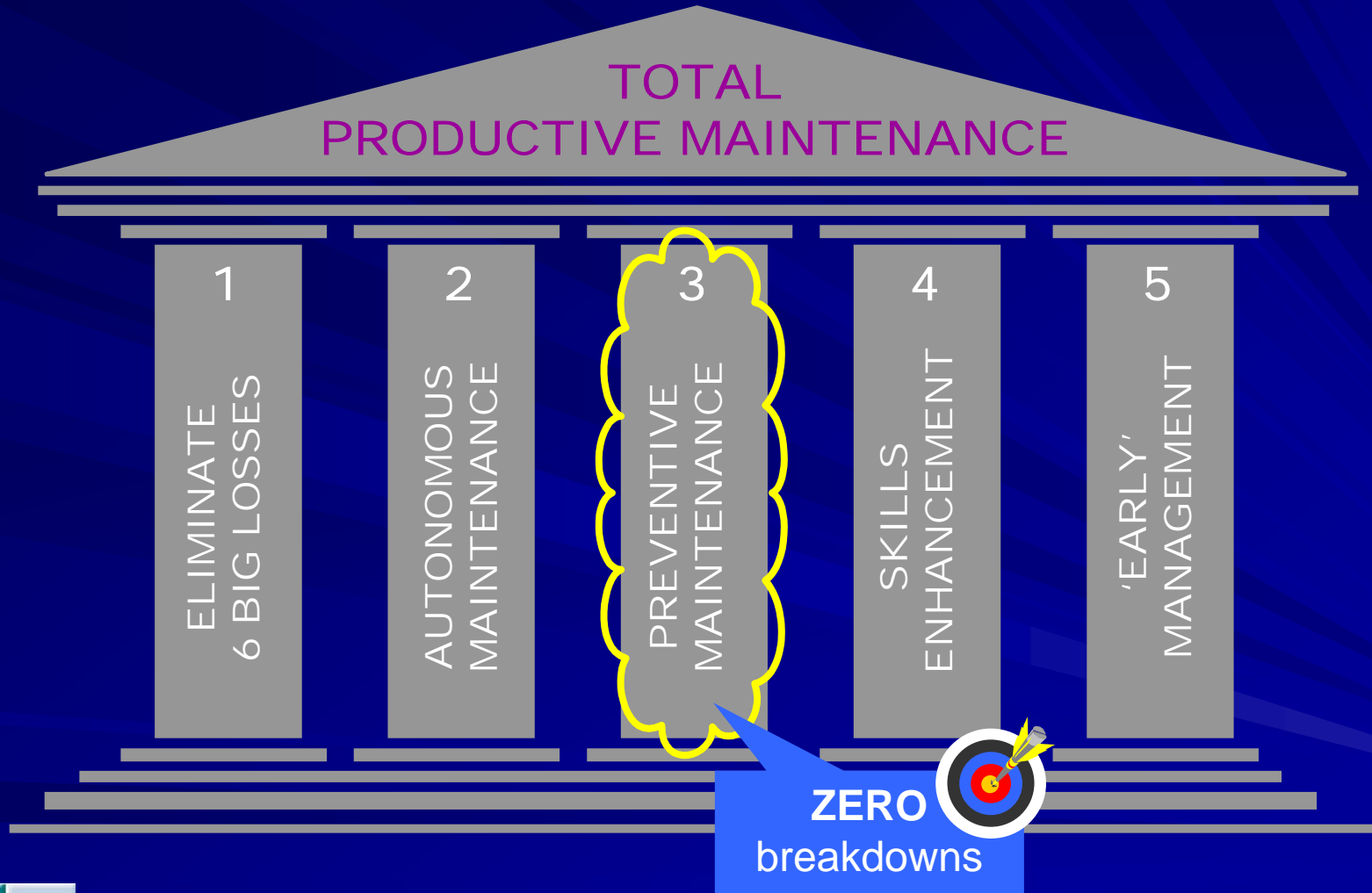


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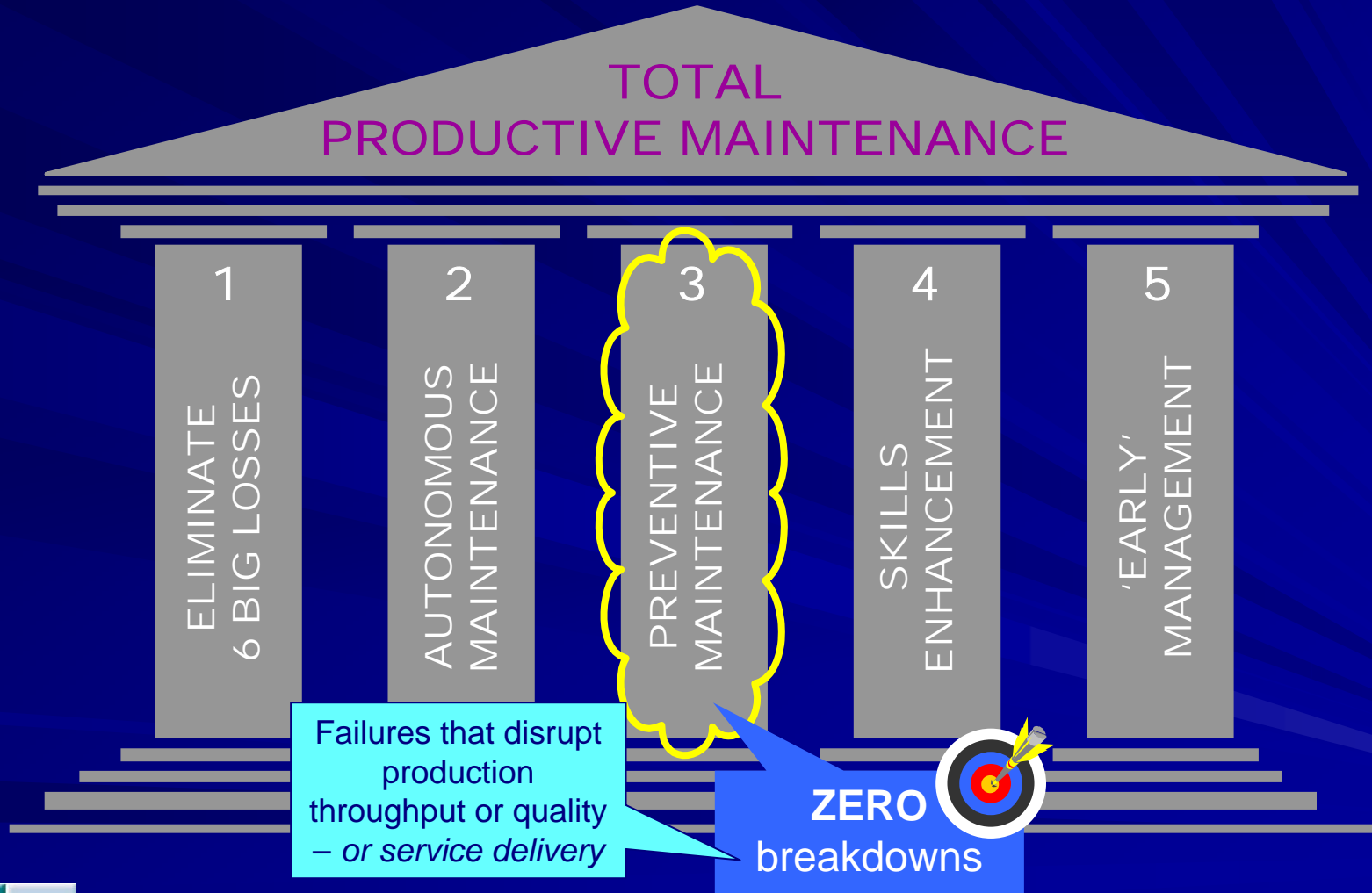


**We break
- you fix!**
avoids this mentality

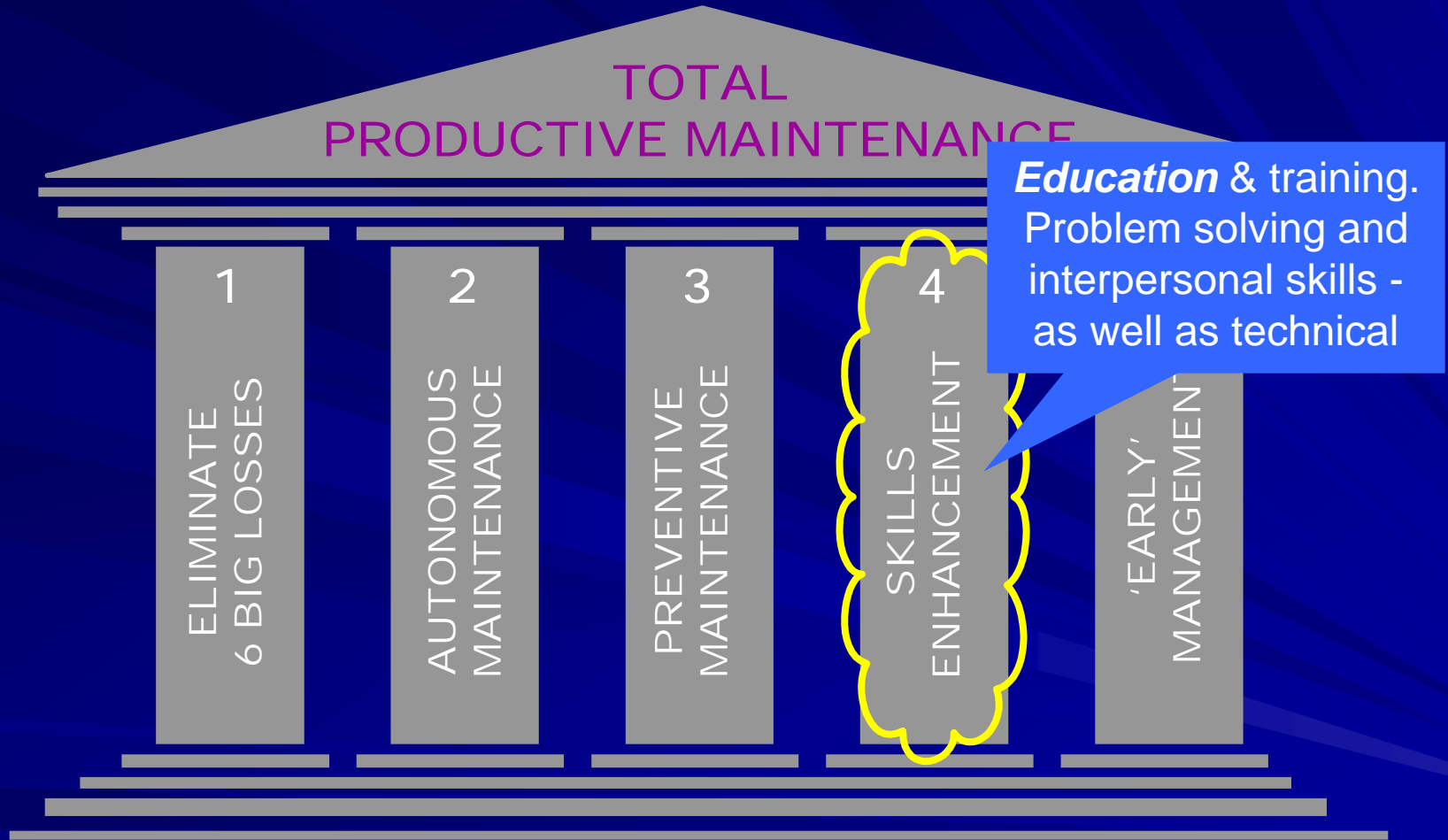
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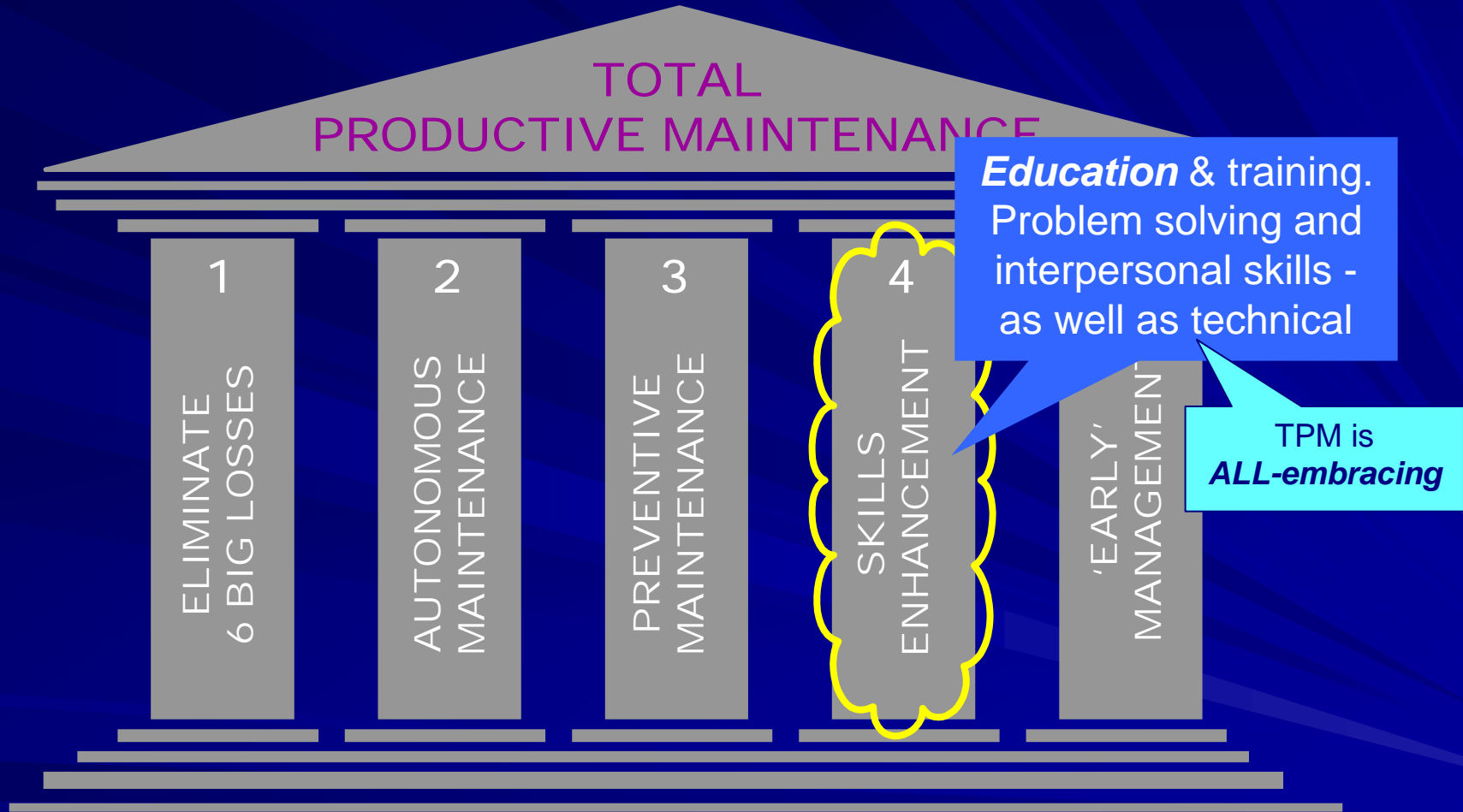
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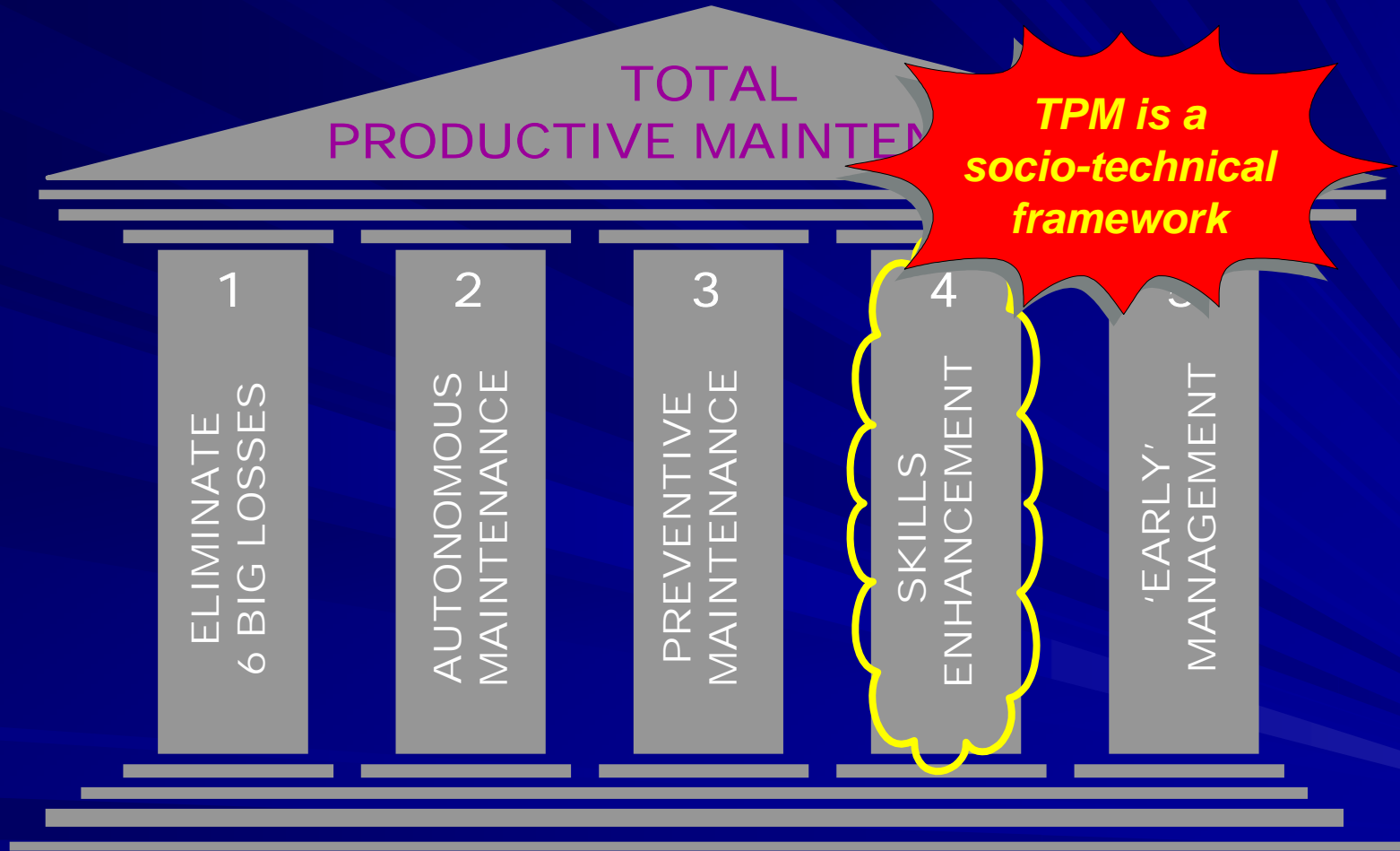
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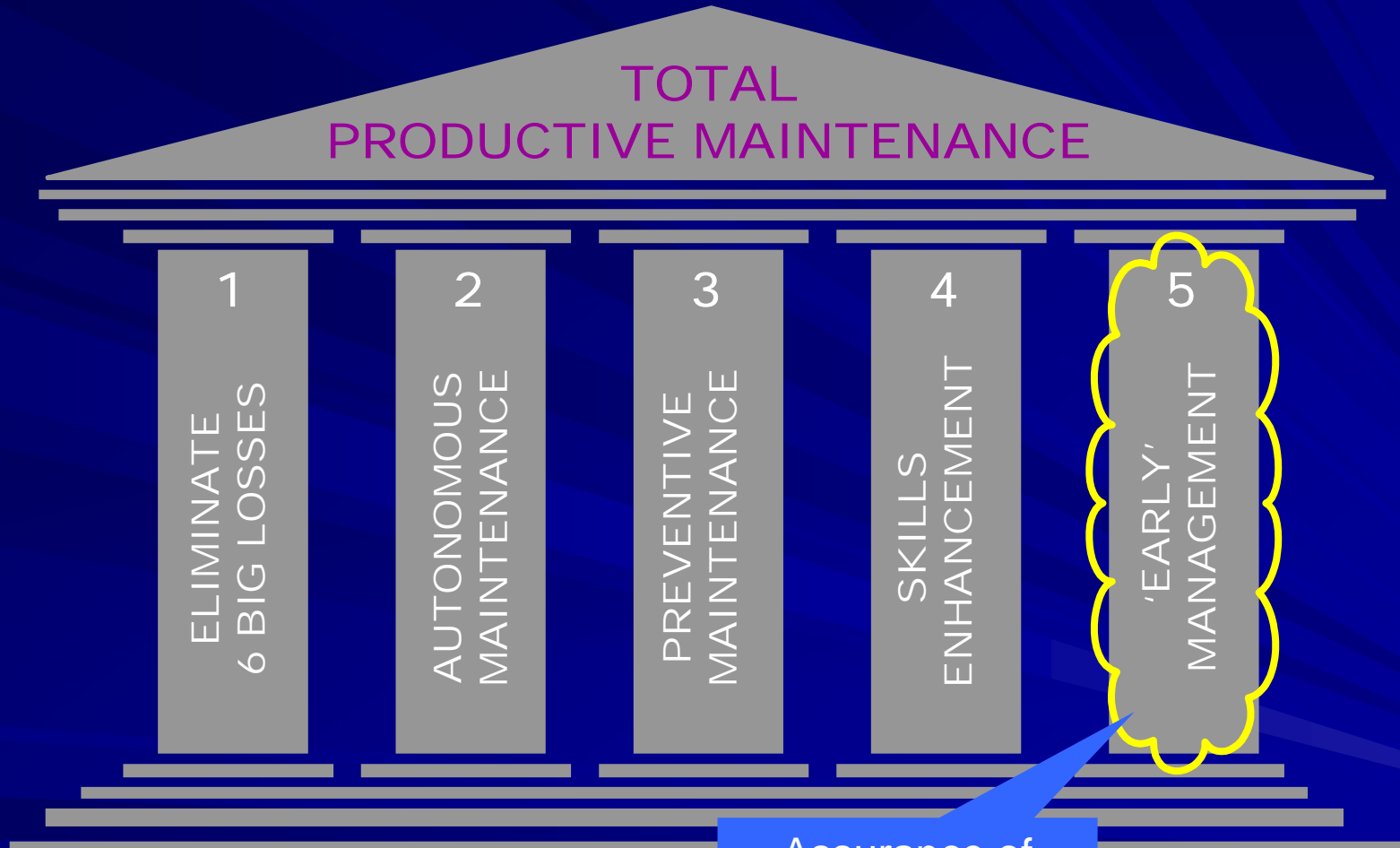
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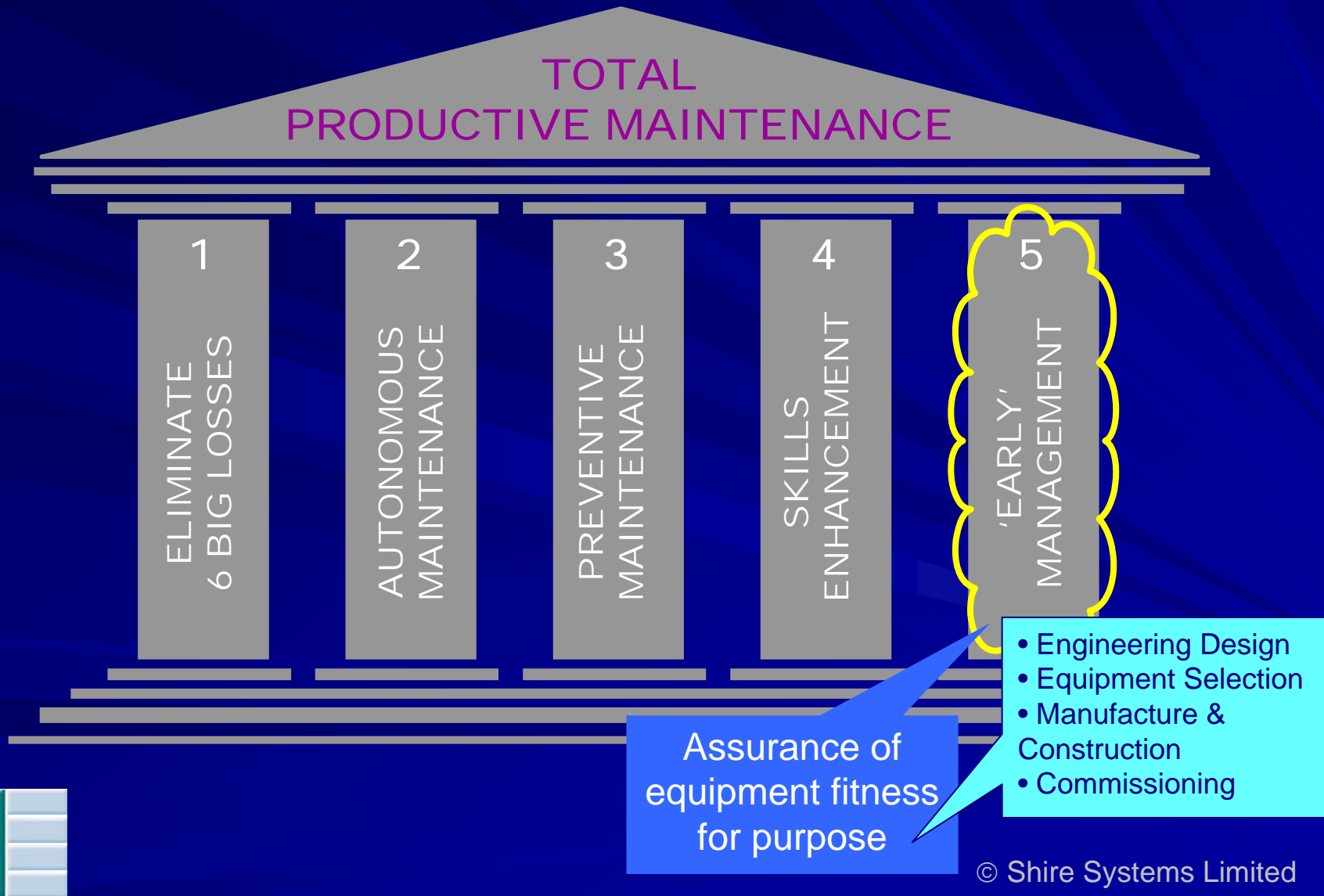
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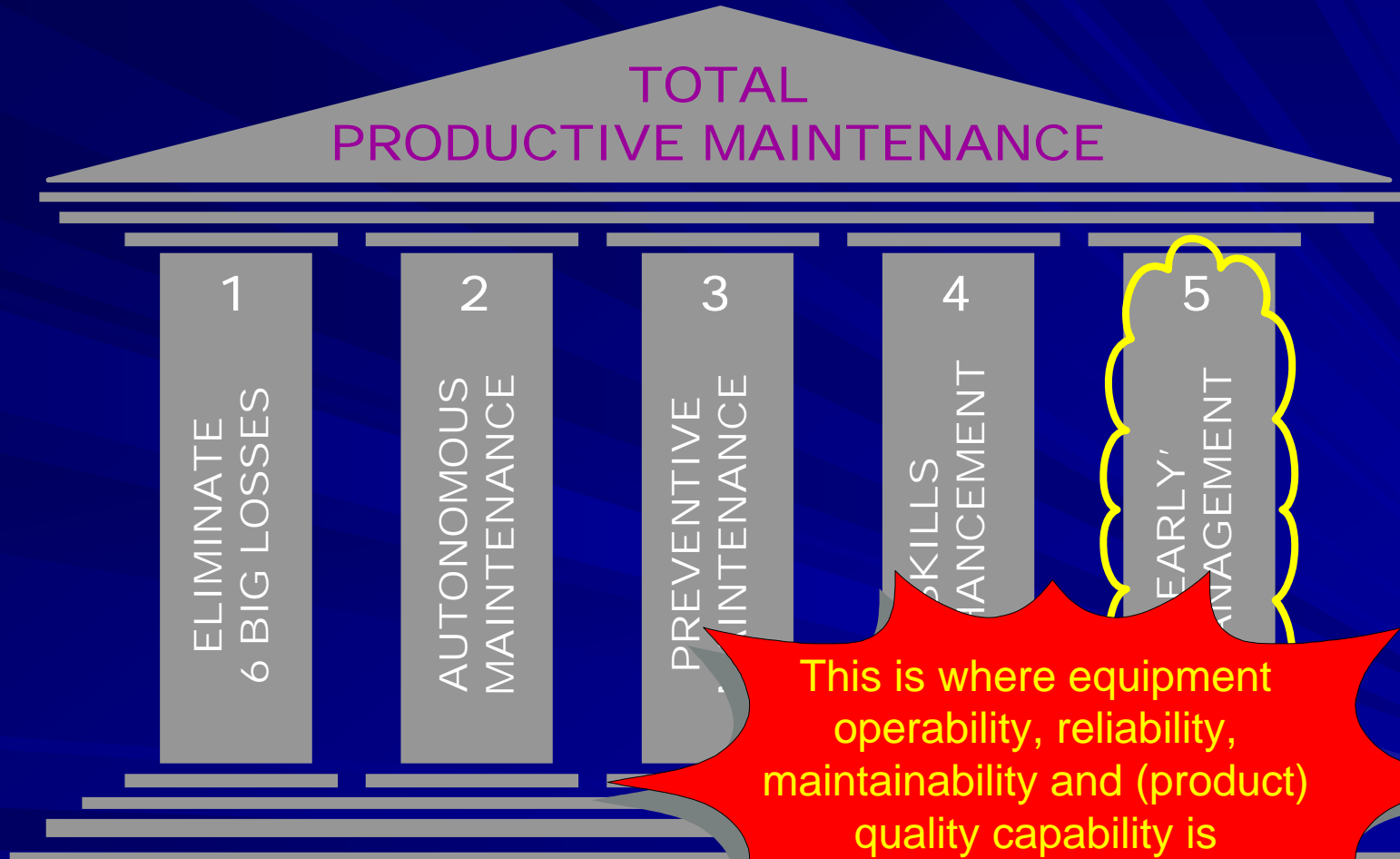
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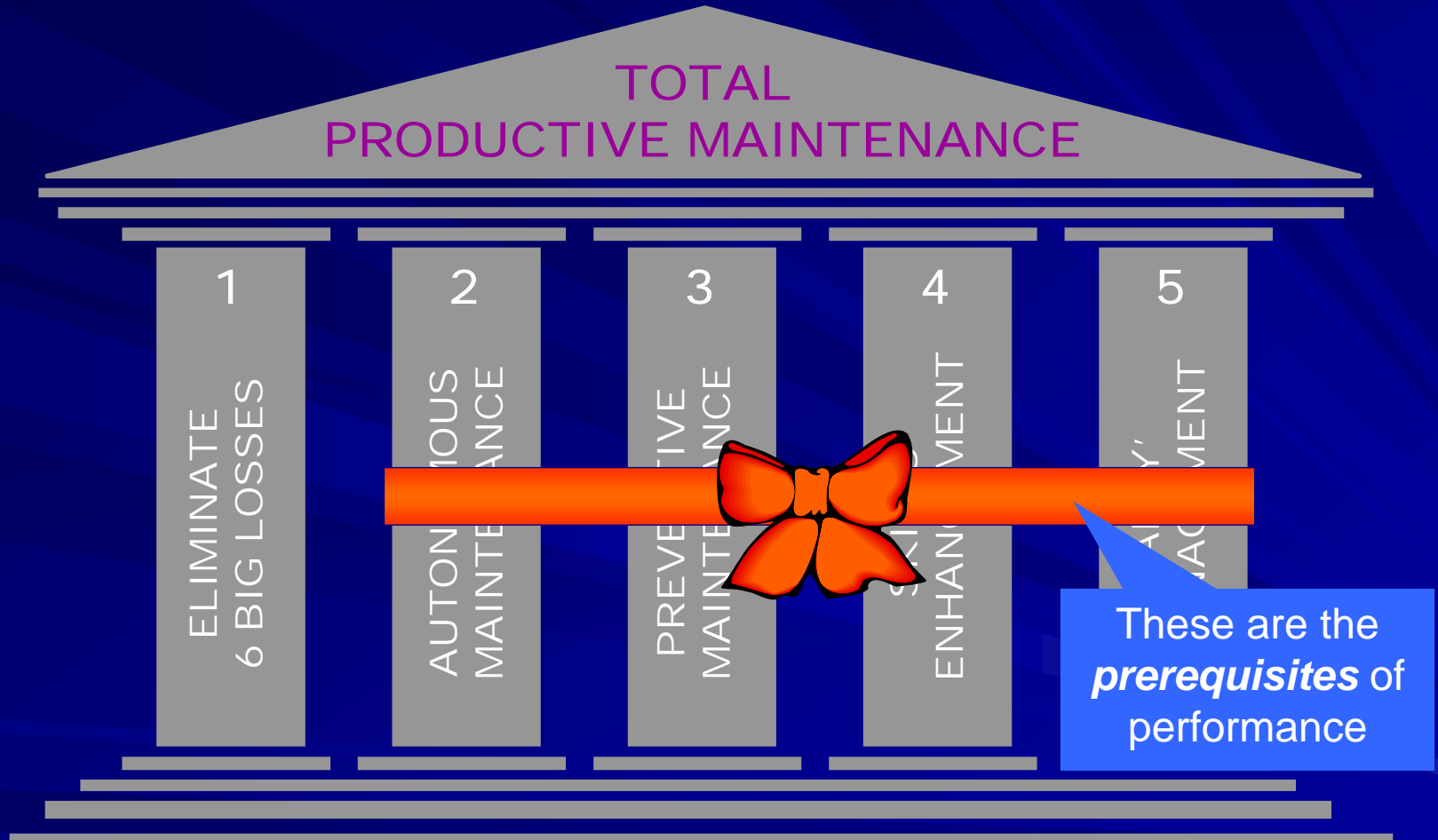


TPM - the basic '5 pillars'

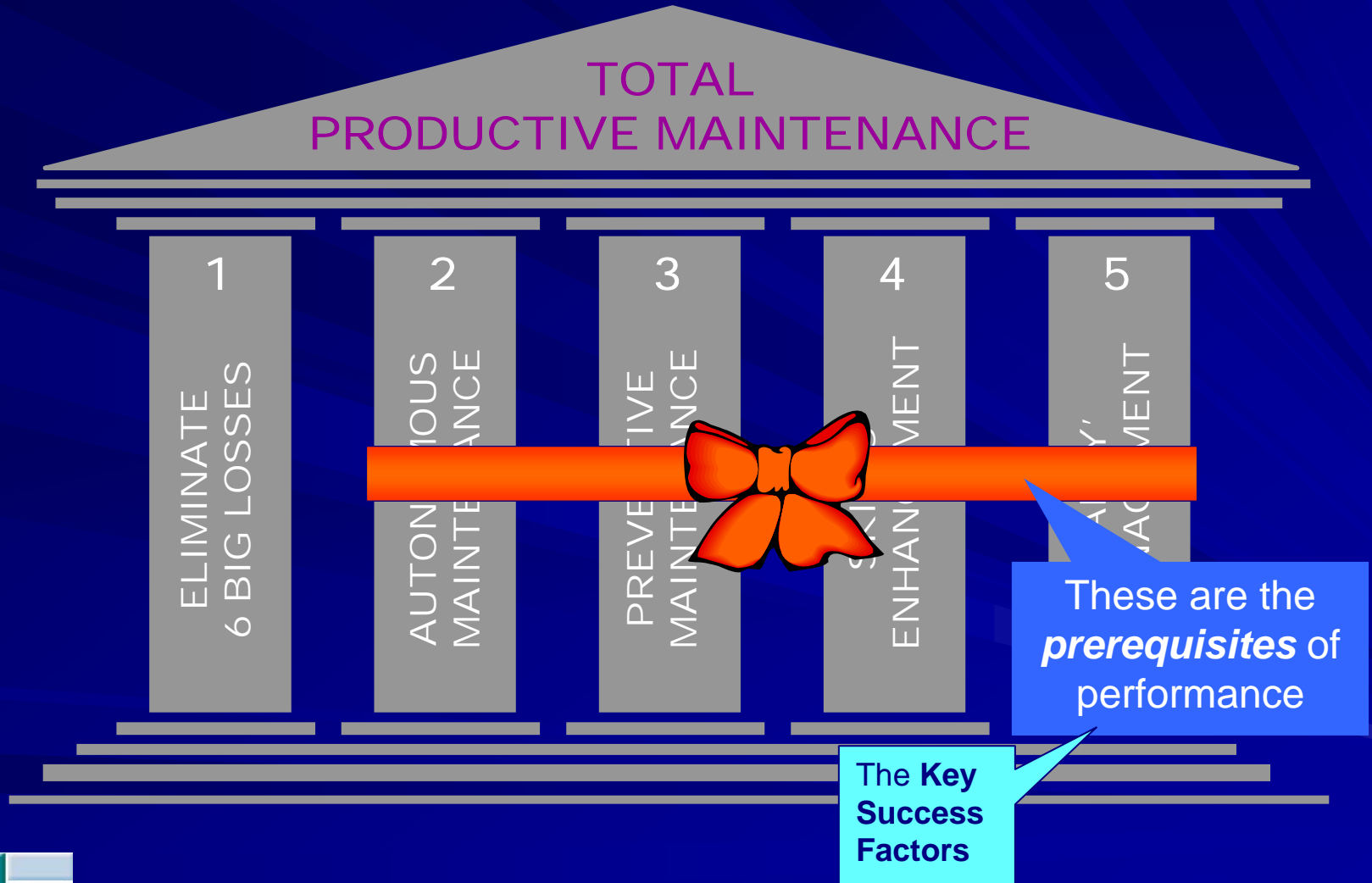


This is where equipment operability, reliability, maintainability and (product) quality capability is fundamentally determined

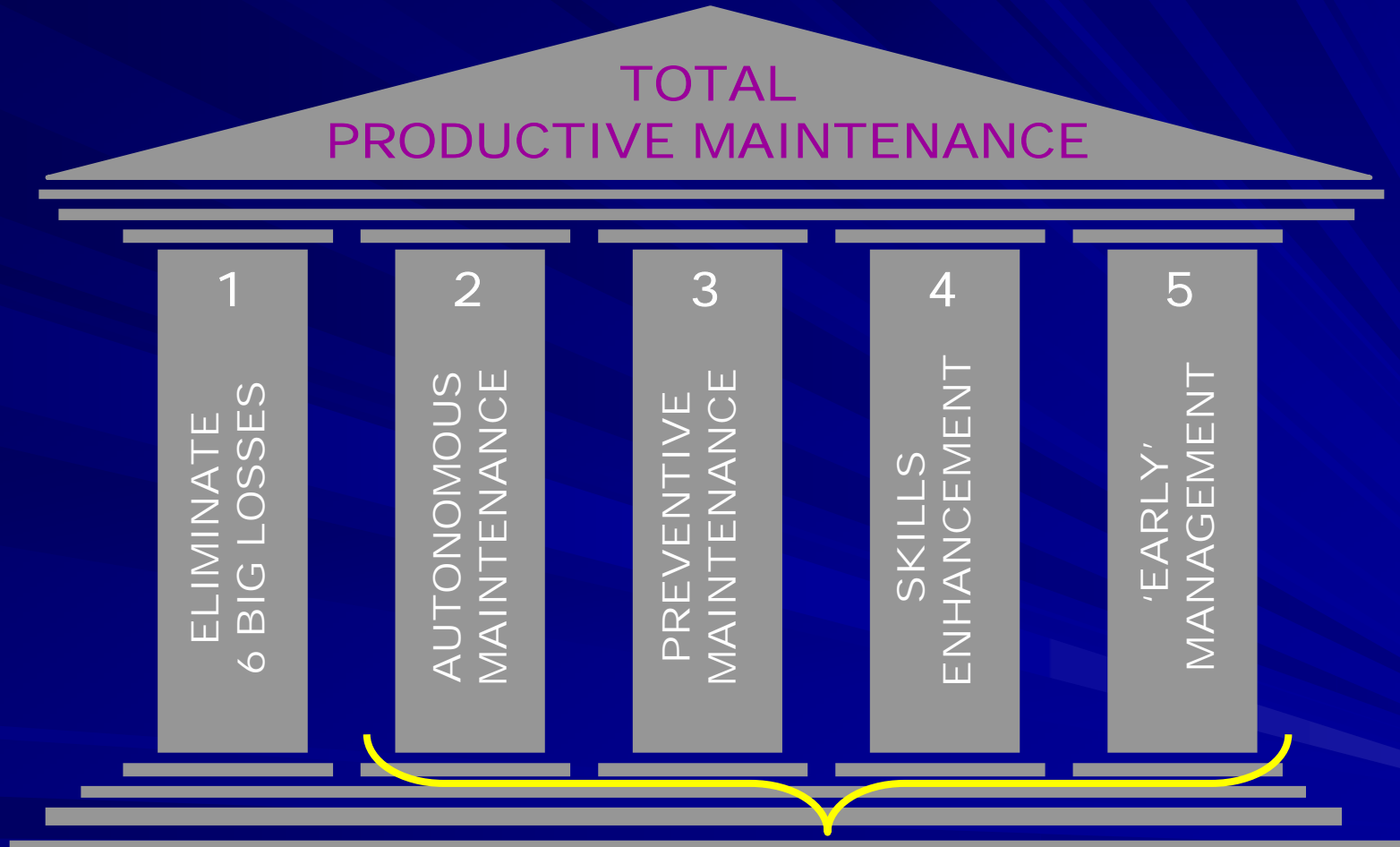
TPM - the basic '5 pillars'



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Do these properly...

TPM - the basic '5 pillars'

TOTAL
PRODUCTIVE MAINTENANCE

1

ELIMINATE
6 BIG LOSSES

2

AUTONOMOUS
MAINTENANCE

3

PREVENTIVE
MAINTENANCE

4

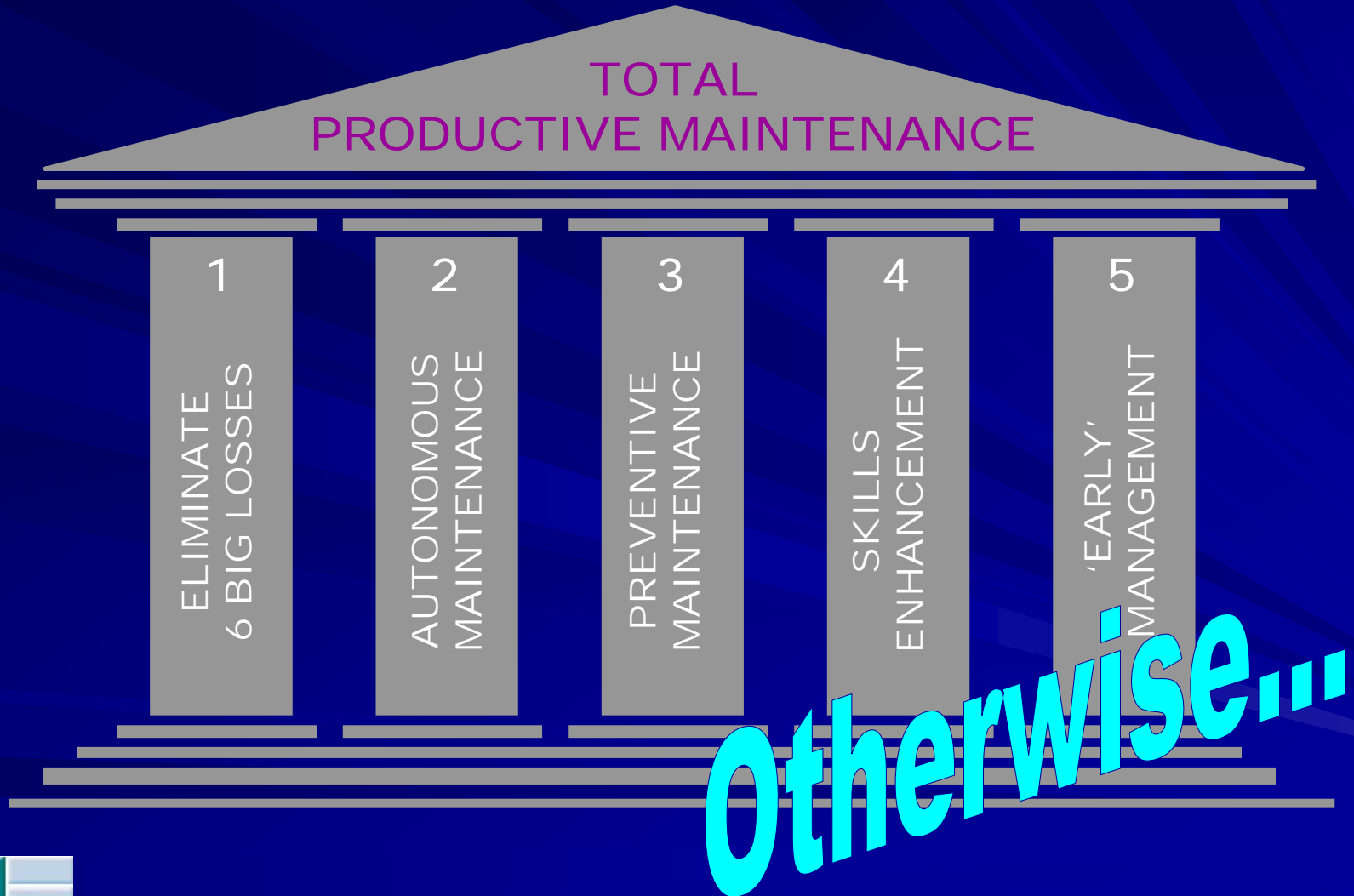
SKILLS
ENHANCEMENT

5

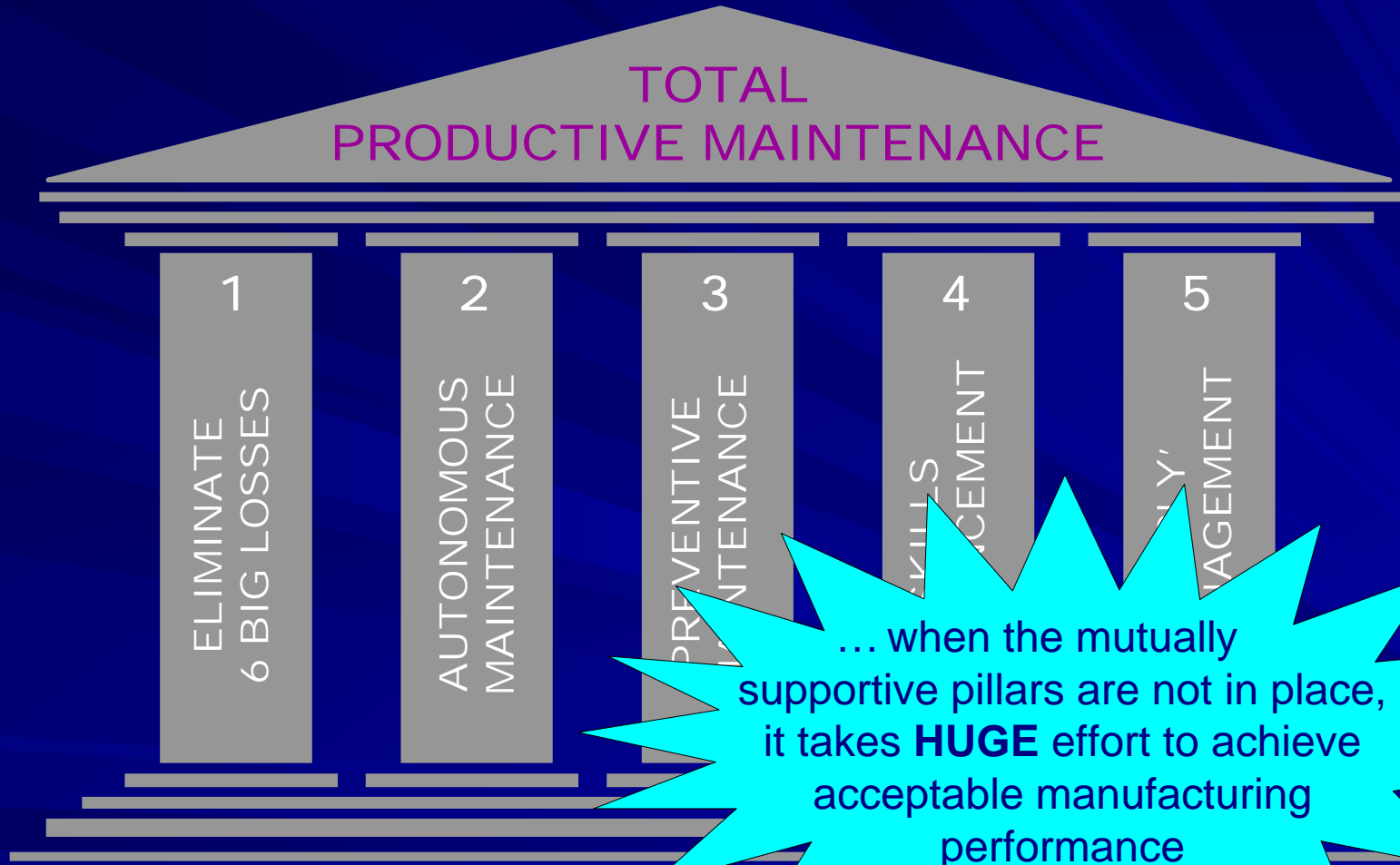
'EARLY'
MANAGEMENT

Get this...

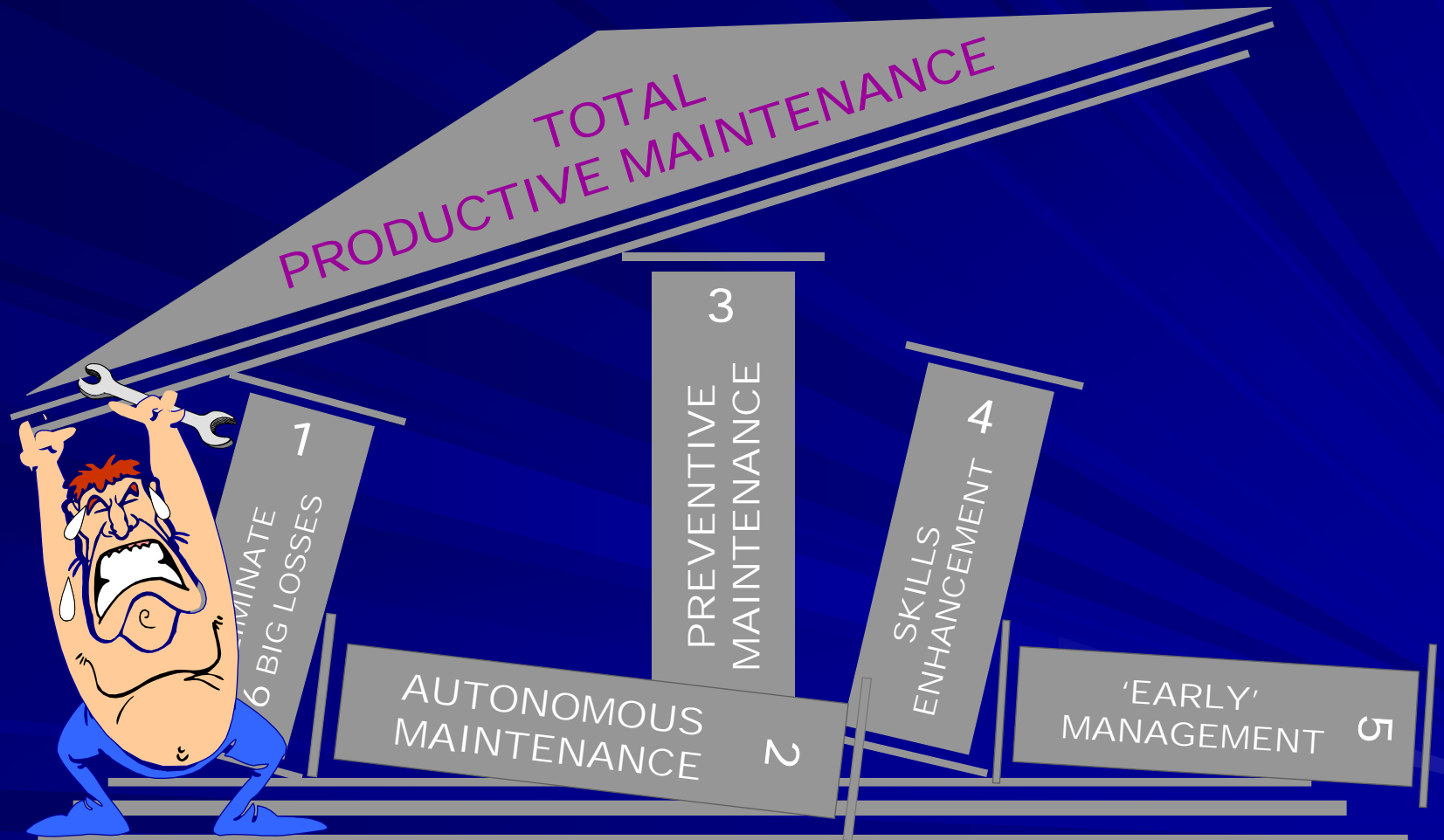
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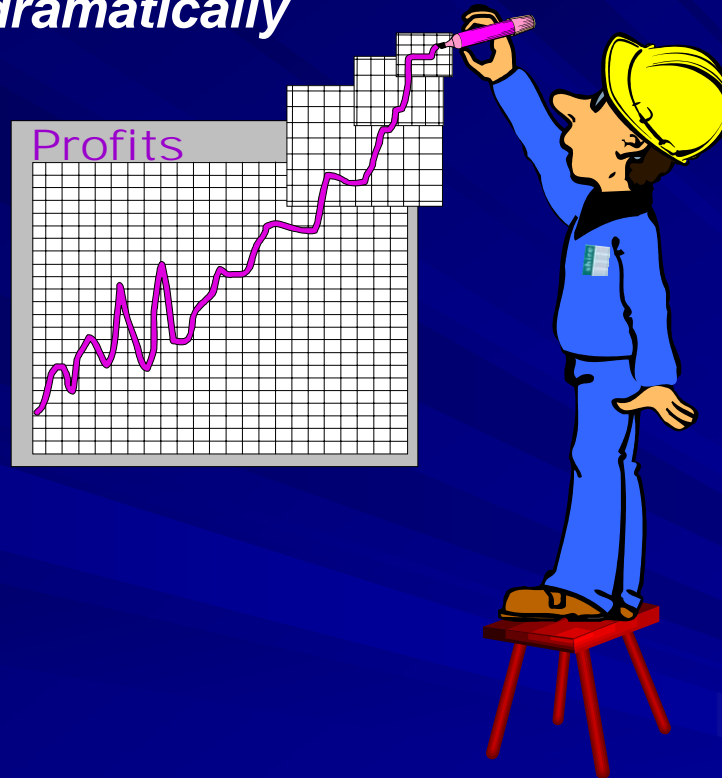


TPM fundamentals



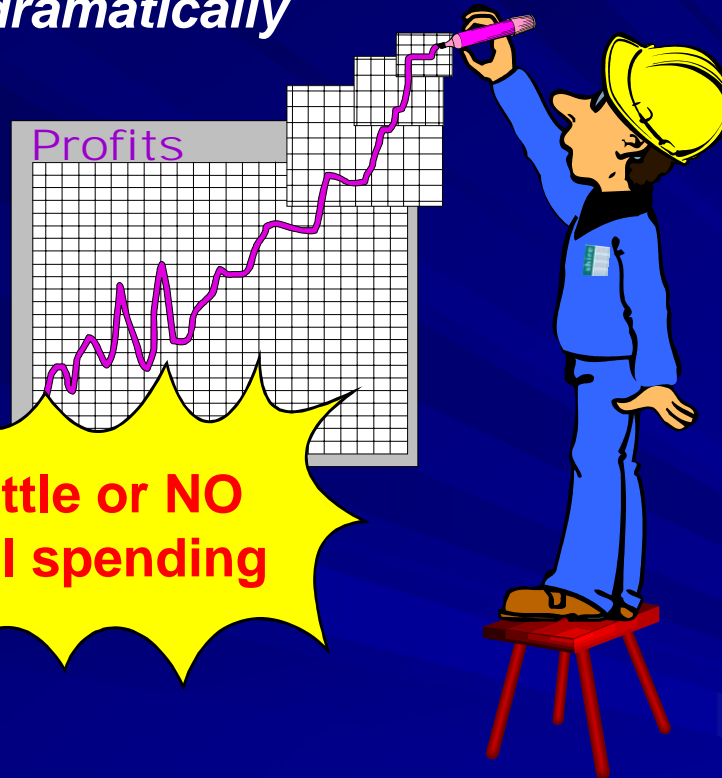
TPM fundamentals

TPM & OEE can increase production profits directly and dramatically



TPM fundamentals

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**For little or NO
capital spending**

TPM fundamentals

TPM & OEE can increase production profits directly and dramatically



For little or NO capital spending

That's why the Japanese developed it – they had no money!

It's a management not a technology initiative



TPM fundamentals

TPM is built on teamwork

Well co-ordinated, cross-functional teams working in common purpose



TPM fundamentals

TPM is built on teamwork

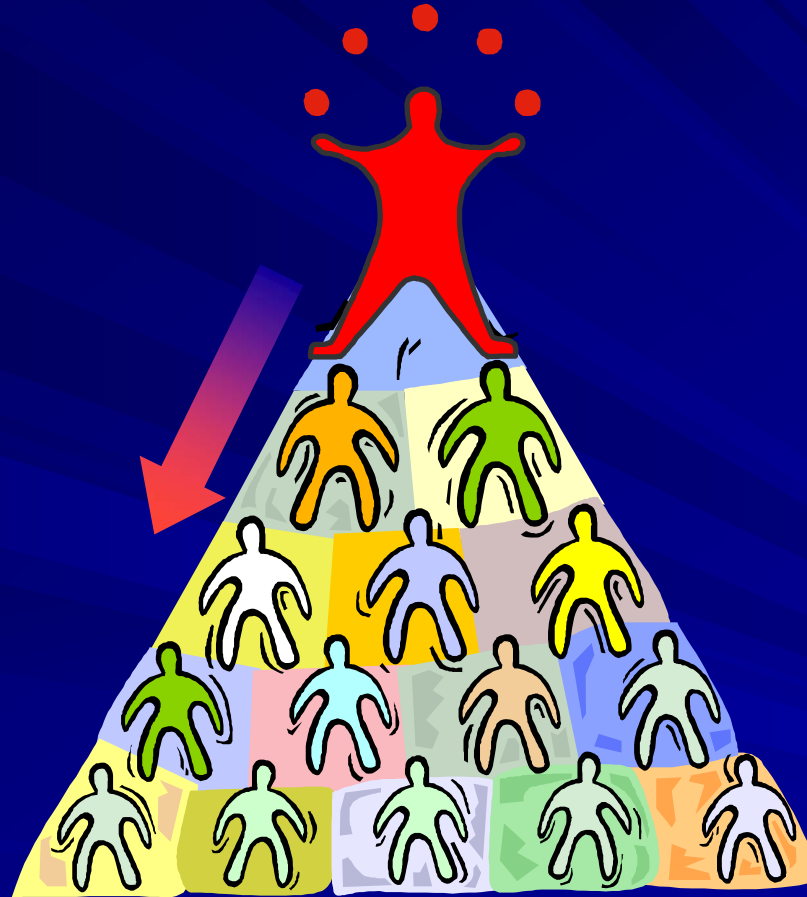
Well co-ordinated, cross-functional teams working in common purpose

**To avoid the
6 BIG losses**



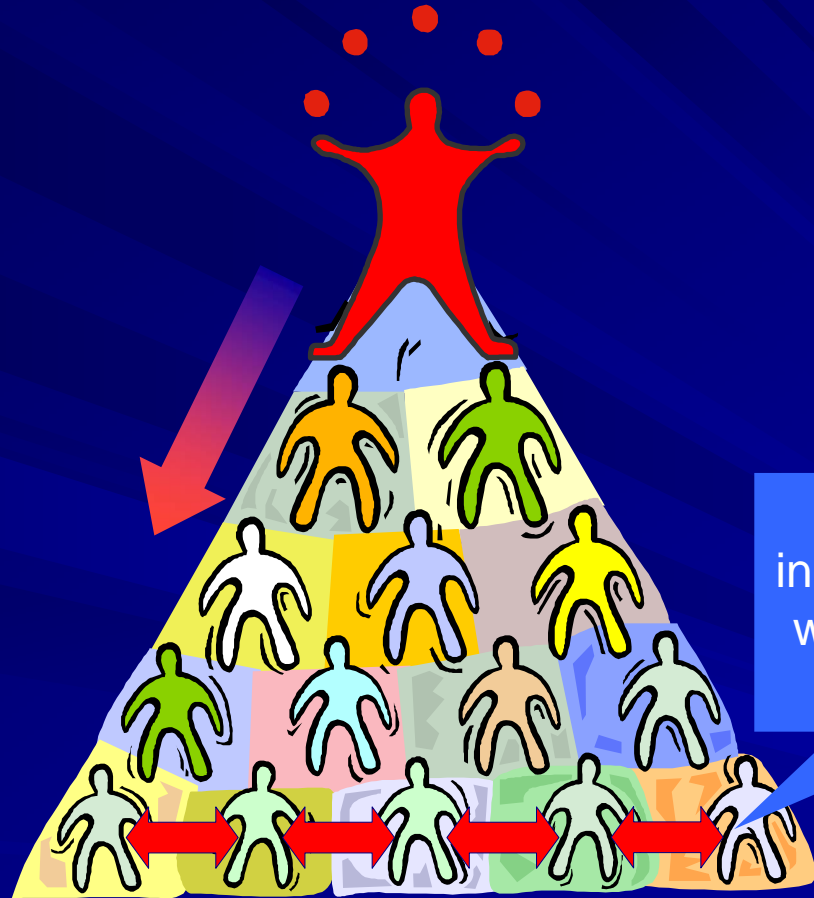
TPM fundamentals

TPM is a top-down initiative



TPM fundamentals

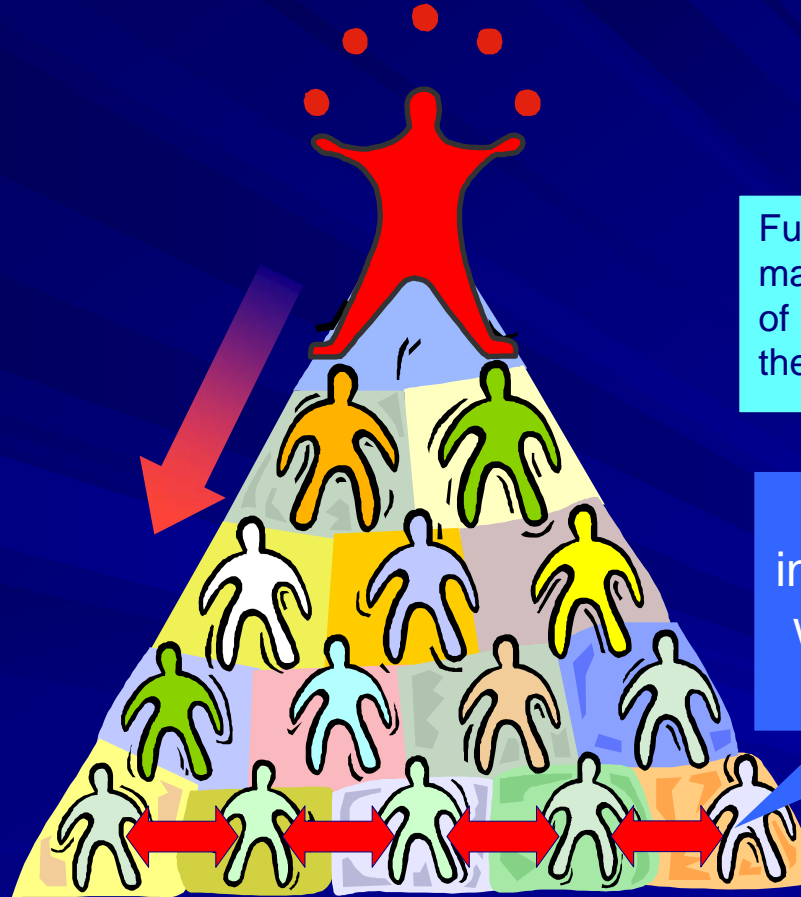
TPM is a top-down initiative



...because the individuals here must work seamlessly as one - NO silos!

TPM fundamentals

TPM is a top-down initiative



Functional and departmental managers resist the removal of silos. The top dog must be the only one that can stop it!

...because the individuals here must work seamlessly as one - NO silos!

<End>

Essential reading:

Introduction to TPM - by Seiichi Nakajima,
Productivity Press

