

Lean Maintenance: Doing More With Less...

Integrating Lean Maintenance with Legacy Systems & Organizations...

Overcoming the Problems & Challenges

by

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Robert M. Williamson

- **Over 35 years teaching & consulting on the “people-side of maintenance and manufacturing improvement for over 400 plant locations**
- **Experienced mechanic, college faculty & technical division director, researcher, and author**
- **Teaching TPM at the University of Dayton since 1996**
- **Linking “NASCAR Race Team methods” with TPM and Lean for over 15 years**
- **TPM Consulting since 1990: DuPont, Alcan, Coca Cola, Alcoa (multiple plants), USPS, Dayton Technologies, Michelin, Anheuser-Busch, Polymer Group, Yamaha...**
- **Teaching “How to Link TPM and Lean Manufacturing” since 1998**
- **Developed a line of proven TPM products & publications sold in 22 countries and 48 states since 1994**

Lean Maintenance: Doing More With Less...

Abridged Dictionary:

Lean (adj.): Fit slim, slender. (**stout**: antonym)

Lean Manufacturing (adj.): Producing (doing) more with less of everything; eliminating waste to reduce manufacturing costs. (**mass production**: antonym)

Maintenance (noun): sustaining, preserving a desired state or level of performance. (**destruction**: antonym)

Repair (verb): to correct damage; fix, patch up; restore, get working again. (**break**: antonym)

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The challenges of "Lean"...

- Declining state of maintenance & manufacturing in the U.S. in the past two decades
- Retiring "Baby Boomers" and the shortages of labor, skills, and knowledge
- Vanishing vocational-technical, industrial arts programs
- Traditional operating and maintenance methods tend to be out of date and inefficient
- Competitive pressures and the "Lean Bandwagon"...

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Integrating "Lean" methods with legacy systems and organizations is the REAL challenge!...

- From 1952 through 1975 Great Britain was the second-largest auto producer and THE largest auto exporter in the world.
- During the late 1970s and 80s the British auto industry was unable to embrace "lean" and "high performing workplace" methodologies to retain their competitive advantage...
(5.5 equiv. MVs/employee/year vs. 26.1 in U.S.).
Their nameplates, jobs, & plants vanished!
- The last remaining British domestic auto maker, MG Rover Group Ltd., filed for bankruptcy in 2005 after closing its 5,000-worker plant in Coventry, England.

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Integrating "Lean" methods with legacy systems and organizations is the REAL challenge!...

WARNING: Similar warning signs are apparent in the U.S. auto manufacturing companies and suppliers NOW!

- 27 Foreign auto manufacturing plants valued at \$34.7 billion in the U.S. in 13 states employing over 65,000 are **showing that "Lean" methods truly work in the U.S. manufacturing sector!**

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What is "Lean"

Very abridged...

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The roots of "Lean"...

In the late 1980s the term "*lean*" was coined by researcher John Krafcik...

"Lean production is 'lean' because it uses less of everything compared with mass production."

From a study out of MIT International Motor Vehicle Program published in 1990 as a book entitled "*The Machine that Changed the World*" by Womack, Jones, and Roos. Harper Collins

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The roots of "Lean"...

In this MIT study...

The Toyota Motor Company was credited with pioneering the concept of lean production that was copied by other Japanese companies

"World-Class Manufacturing"
"Just-in-Time Manufacturing"

From a study out of MIT International Motor Vehicle Program published in 1990 as a book entitled *"The Machine that Changed the World"* by Womack, Jones, and Roos. Harper Collins

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The roots of "Lean" in Toyota...

The underlying principle of the "Toyota Production System"...

"Eliminate waste to reduce manufacturing cost"

TPM came along in the late 1960s to apply proven company-wide approaches...

"Eliminate equipment losses"
"Improve equipment effectiveness"

Why? Because...

"It is impossible to consistently produce quality products on poorly maintained machines"

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Program-of-the-Month Apathy...

Remember what was HOT in the 1970s, 80s, and 90s?

- *Employee involvement, participative management*
- *Socio-technical systems, high-performing work places, high-performing work teams*
- *Quality control circles, Statistical Process Control*
- *Total Quality Control, Total Quality Management*
- *Just-in-time manufacturing*
- *TPM, Autonomous Maintenance*

If your company has struggled with these, be careful NOT TO REPEAT the same mistakes!

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Program-of-the-Month Apathy...

- **At least 50-60% of the TPM programs started since the late 1980s have failed to show sustainable results**
- **About 98% of the "5S" programs started in the past 15 years have failed or gone dormant after 18 months**
- ***"LEAN and TPM: Here we go again?"***

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What is our "Maintenance" history...

- *Maintenance is the least defined of all industrial activities...*
- *Mid- to small-sized companies have struggled with this "overhead," indirect cost activity: Cost cutting prevailed*
- *Many (>75%) maintenance, PM, PdM, CMMS, RCM, RCFA, training programs have not been sustained... results have not been realized*

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Our challenge...

Overcoming traditional perceptions and paradigms about maintenance,

Integrating "Lean thinking" with our plant's legacy systems...

and our legacy organizational structures.

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Making "Lean Maintenance" work... *(making "maintenance" work in a Lean organization)*

- **Beware of labels:** TPM is the original "lean maintenance"
- **Leadership:** Lead! Focused, decisive leadership.
- **Compelling business cases** drive lean & culture change
- **Vision:** Aligned, focused on common goals
- **Strategy:** A clear path to achieve the vision
- **Culture change:** knock down the barriers. Change!
- **WIIFM:** Compensation equity, job satisfaction, camaraderie

More...

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Making "Lean Maintenance" work...

- **Standardized work:** Drive out human variation:
Procedure-based maintenance & operations.
- **Training & qualification:** Focus *task-specific* training
on fast & sustainable results (*"TWI" - Productivity Press*)
- **Focus on results:** Avoid the "Activity" or
"Programmatic" approach of implementing lean tools
in the hopes of improving performance
(it rarely works)
- **Focus on results:** Address the compelling business case
for very specific improvement in revenue,
throughput, costs, waste...
See your own business KPIs

More...

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In your quest for "Lean" pick the right tools for the job!

Contrary to popular belief, there is NO "Lean Gizmo" that does it all ("Kaizen Blitz, Lean Sigma, 5S...")

Many "Lean-type" efforts failed in the past 20 years because the decision-makers became enamored with the "tools" and activities...

losing sight of the fast, focused, and sustainable gains possible with "true lean" (*the systematic identification and elimination of waste to reduce cost...*)

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The underlying principle of TPS/Lean, TPM, Six Sigma...

The scientific method* ...
"The most reliable of all methods of knowledge"

```
graph TD; 1[1. Identify the Problem] --> 2[2. Gather Data - Define the Problem]; 2 --> 3[3. Establish Hypothesis]; 3 --> 4[4. Conduct Experiment]; 4 --> 5[5. Verify Hypothesis]; 5 --> Worked[Worked]; 5 --> DidnWork[Didn't Work]; Worked --> 6[6. Make Changes]; DidnWork --> 2; 6 --> People[• People]; 6 --> WorkProcesses[• Work Processes]; 6 --> Equipment[• Equipment];
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• People
• Work Processes
• Equipment

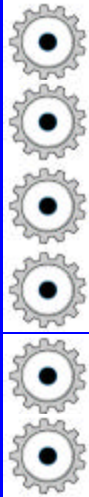
Plan
Do
Check
Act


Often the weakest link is problem solving!

* Summarized from:
"www.scientificmethod.com"

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Five Basic Pillars of TPM Plus One (Williamson's update)...



1. Improving equipment effectiveness by targeting the major causes of poor performance 
2. Involving operators in the routine maintenance of their equipment (Not truly "autonomous" maintenance)
3. Improving maintenance efficiency & effectiveness
4. Improving skills and knowledge
5. Designing for operability and maintainability throughout the equipment life cycle
- + 6. Winning with teamwork focused on common goals

Targeting the Major Losses... (Data that guides all TPM activities)

Availability

- A. Planned shutdown losses:
 1. No production, breaks, shift change, etc.
 2. Planned Maintenance
- B. Downtime losses:
 3. Waiting for Operators
 4. Failure or breakdowns
 5. Setups & Changeover
 6. Tooling or Part Changes
 7. Startup & Adjustment
 8. No room for output
 9. No incoming materials
- C. Performance efficiency losses:
 10. Minor stops (less than 6 minutes)
 11. Reduced speed or cycle time
- D. Quality losses:
 12. Scrap product / output
 13. Defects, rework
 14. Yield / Transition



**"Maintenance
cannot do it alone!"**

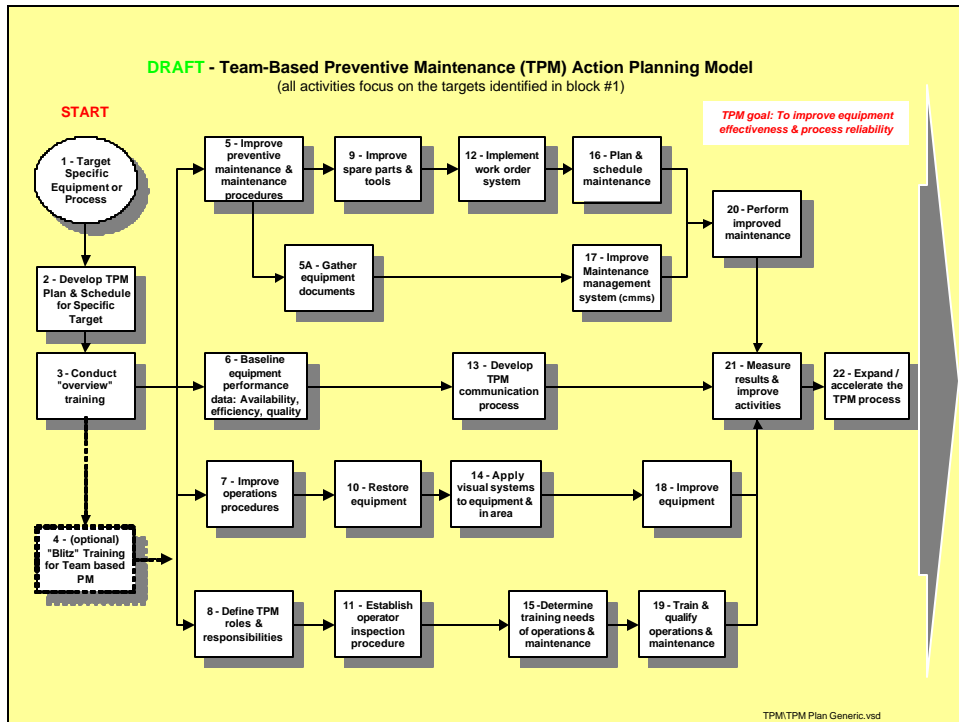
Integrating Lean Maintenance

Weld Mill #10		Weld Mill #10 Downtime: Jan - July 2005 (Example Only)	
Down time Code	Sum Of DT Hours		
EIAH	1.7	Power Failure	
EIB	1	Hydraulics	
EIC	1.4	Electrical – General	
EIG	3	Mechanical Failure	
EIP	4.8	Abrasive /Cold Cut / Band Saw	
EIU	0.5	No Cooling Water	
EIW	0.2	Torch Adjustment Problems	
EIX	91.3	Hammer Unit /Tibo Problems	
EIY	10.5	Broken Manipulator Arms	
EIZ	2.5	Other - Explain	
MIA	2	Material – Unavailable	
MIC	10	Getting Material	
MIF	20.8	No Material	
MIG	1	Crane Unavailable	
PIA	0.8	Operator unavailable	
PIB	8.1	Cleanup	
PIG	2.8	Support Resources Not Avail.	
PIH	2.7	Trial / Sample Disruptions	
PII	17	Communications Meetings	
PIK	1	Operator on Break	

PIV	32.3	Work on Other Operations
PIW	5	Butt Weld
PIX	70.65	Wall Change
PIZ	23.8	Other - Explain
TIA	0.4	Tooling Not Available
TIC	19.7	Setup / Changeover
TII	0.5	Broken / Missing Tool
TIN	0.8	Change Blade
TIO	0.7	Change Purge Tube
TIP	19.8	Change Electrode
TIQ	43.3	No Mill Order
TIR	23.2	Mandrel Pullout
TIZ	4.1	Other - Explain
427.35	Total DT	
116.9	Equipment	
33.8	Materials	
112.5	Tooling	



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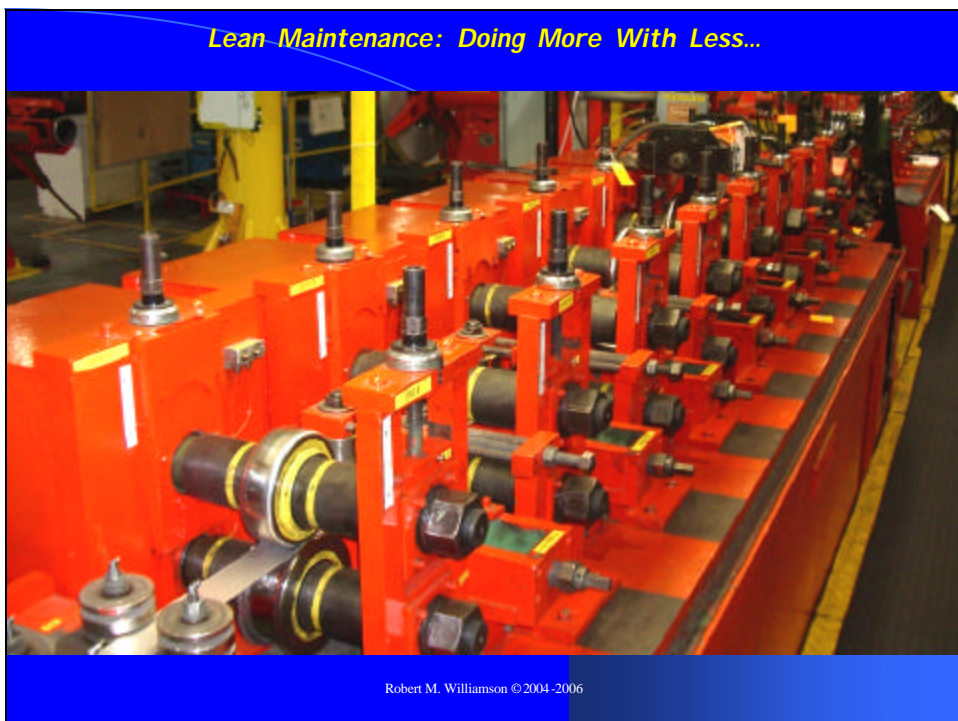
Integrating TPM and Lean with Legacy Systems and Organizations...

- Emphasize the "business case" for change
- Change. Overcome the inertia of the past ways.
- Re-focus the entire organization
- Culture change
- Paradigm shifts
- Abandon out-dated ways
- Reinforce the desired behaviors and results

What are the alternatives? Consider them. Discuss them.

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Integrating Lean Maintenance



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We are a Nation at risk!

And very few people realize it!

The performance and reliability of our equipment-intensive industries MUST be improved...

Many of the "traditional" approaches will no longer be effective.

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11 U.S. Capital-Intensive Business Sectors Are At Risk...

Gross output and Total Employment year ending 2004:

Industry	% of Gross Output	Gross Output Dollars (2004)	% of Workforce	Full time Employees (equivalents)(2004)
Manufacturing*	20.20%	\$4,311,624,000,000	11.33%	14,112,000
Accommodation and food services	3.80%	\$696,596,000,000	6.82%	8,491,000
Broadcasting and telecommunications	3.02%	\$645,152,000,000	1.07%	1,327,000
Transportation and warehousing	3.00%	\$640,421,000,000	3.25%	4,052,000
Hospitals & nursing residential care facilities	2.68%	\$571,571,000,000	5.22%	6,494,000
Utilities	1.73%	\$368,508,000,000	0.45%	562,000
Agriculture, forestry, fishing, and hunting*	1.49%	\$319,003,000,000	1.06%	1,319,000
Publishing industries	1.19%	\$254,935,000,000	0.68%	844,000
Oil and gas extractions*	0.89%	\$189,521,000,000	0.10%	121,000
Waste management and remediation services	0.28%	\$59,558,000,000	0.25%	314,000
Mining, except oil & gas*	0.26%	\$55,150,000,000	0.16%	204,000
	38.54%	\$8,012,039,000,000	30.39%	37,840,000

2005, Bureau of Economic Analysis - U.S. Department of Commerce

* Sources of "original wealth" per Alan Greenspan

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We are a Nation at risk!

Small and Medium Manufacturers**

- Comprise about 95% of all manufacturing firms employing about half of all manufacturing employees in the U.S.
- Account for 37 percent of all manufacturing receipts—more than \$1 trillion a year;
- Pay their workers 20 percent more than employees in other types of small business; and
- Export increasingly more each year—the number of SMMs that export more than 10 percent of their sales tripled over the past decade.

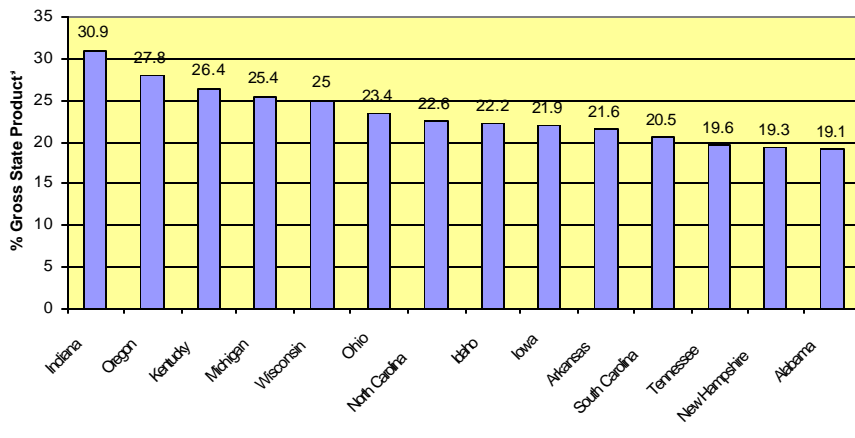
** 2005 National Association of Manufacturers survey of SMM

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14 States in the U.S. with the Most to Gain (or risk losing!)

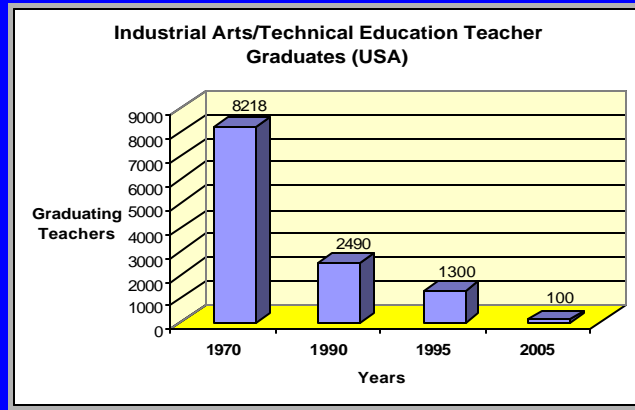
Largest Share of Manufacturing GSP* (Top 14 states)



* Data on "Gross State Product" from National Association of Manufacturers, 2006

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There is a steady decline of technical teachers, and programs...



“As with many other teaching jobs, fewer students are interested in pursuing teaching careers because of the wages and working conditions.”

Kenneth S. Volk reported a major study in the *Journal of Technical Education*

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Over 80% of the maintenance mechanics, electricians, and other crafts in small- to mid-sized plants and facilities...

have NOT been FORMALLY trained to do the work they are asked to do every day!

4TH Pillar of TPM: *Training to improve operating and maintenance skills and knowledge*

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Educate your Local, State, and Federal elected representatives. Seek State & Federal funding and tax credits for improving competitiveness!

WIA of 1998 administered by State and Regional Workforce Investment Boards have funding for unemployed, underemployed, and disadvantaged adults. Governors can make exceptions for where the funds are allocated. Some WIBs have already done this for TPM and Lean Training!

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Here's what you can do now for fast results

1. Identify the "problem." Target the major equipment-related losses in the plant
(TPM Pillar #1: 14 Major Equipment-Related Losses)

- ☑ **Equipment data:**
OEE, work order history; people, go see...
- ☑ **Maintenance data:**
Work orders, MTBF, MTTR, costs
- ☑ **Production & quality data**
- ☑ **Cost data**

2. Gather data to define the extent of the problem(s)

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3. Establish ideas to address (eliminate) the causes of the problem. Consider each of these:

- ☑ *Involving the equipment operators in equipment care*
(TPM Pillar #2)
- ☑ *Improving maintenance efficiency: PM, PdM, CMMS, parts rooms, documents, etc.* (TPM Pillar #3)
- ☑ *Training to improve operating and maintenance skills*
(TPM Pillar #4)
- ☑ *Making the equipment easier to operate and maintain* (TPM Pillar #5)
- ☑ *Keeping leadership and teamwork focused on a common goal. Everyone who affects equipment performance and reliability must be on board.*
(TPM Pillar #6)

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4. Try each idea. Conduct an "experiment."

5. Verify the idea: Did it work? (Go to Step 6). Or, did it fail? (Go to Step 2).

6. Establish the proven idea as a new "best practice." Address improvements to the people, the equipment, and the work processes (methods). Go back to Step 1.

NOTE: This proven six-step process follows the *Scientific Method*, the Shewhart Cycle, the Deming Wheel (*Plan-Do-Check-Act*), Six Sigma's *DMAIC* analysis (Define, Measure, Analyze, Improve, Control), and the basic *Pillars* of Total Productive Maintenance (TPM) for improving equipment effectiveness

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***Our future depends on reliable equipment
using low cost/high results methods!***

***There is NO OTHER method as effective
as "true" Total Productive Maintenance***

If you can't make it happen, who can?

You are the TPM and Lean Leaders!

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Overcoming the Problems & Challenges

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