THE BENEFITS OF INDUSTRY COMPETITION IN THE PAVEMENT MARKET: :

And How Agencies can use it to Lower their Pavement Costs

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Acknowledgements to:
R. Kirchain, J. Gregory, T.R. Miller, (MIT Concrete Sustainability Hub); O. Swei (Univ of British Columbia); & L Wathne (National Concrete Pavement Technology Center – CPTech)

ECONOMIC THEORY STATES COMPETITION BETWEEN SUBSTITUTES REDUCES COSTS

Substitute: a product/service that satisfies the need that another product/service also fulfills

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Aluminum and Plastic are Substitutes that Coke Uses to Create Competition

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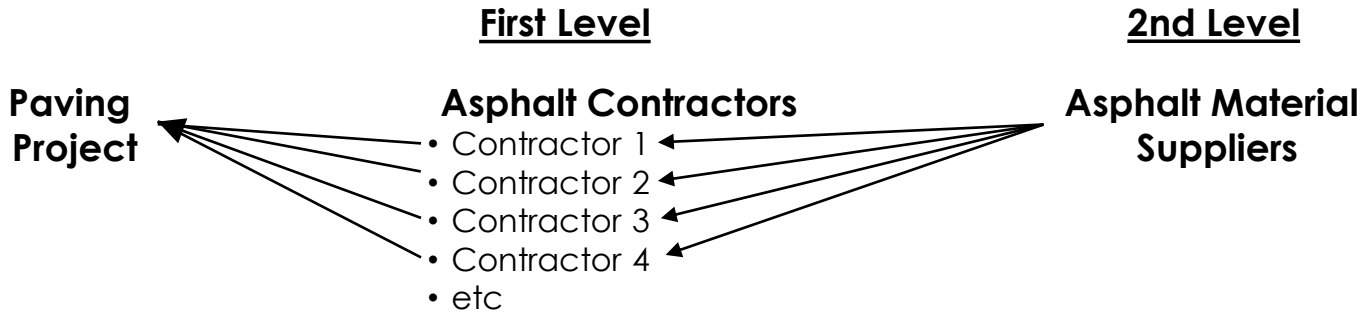
Concrete & Asphalt Pavements are Substitutes that Can (and Should) have the Opportunity to Compete

THERE ARE TWO FORMS OF COMPETITION

Need to Create Competition Brings at all Levels of the Supply Chain

Intra-Industry (Contractor) Competition

Competition Between firms that pave with the same material



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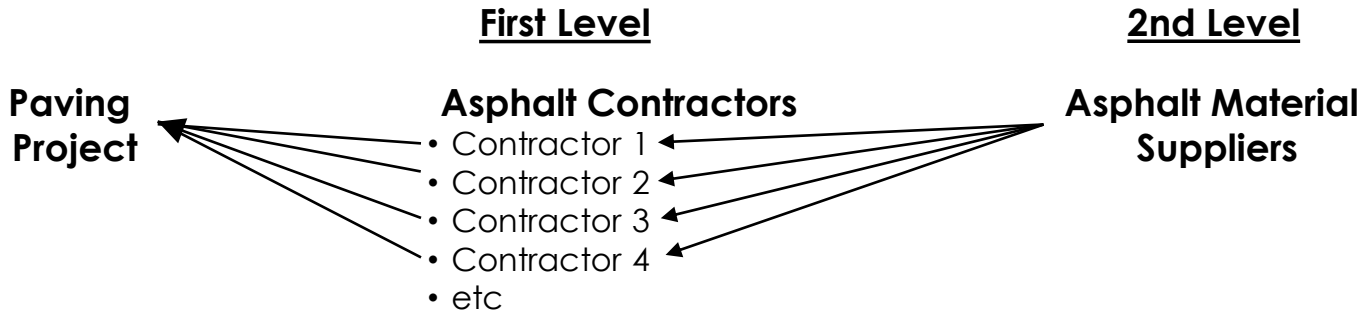
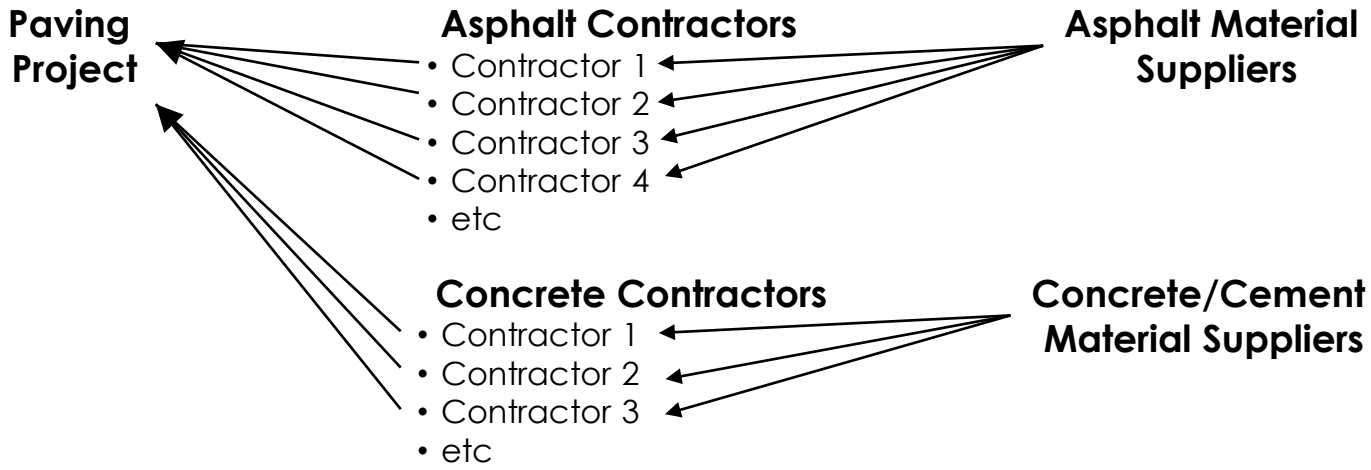


Inter-Industry (Industry) Competition

Competition between firms that pave with different material substitutes

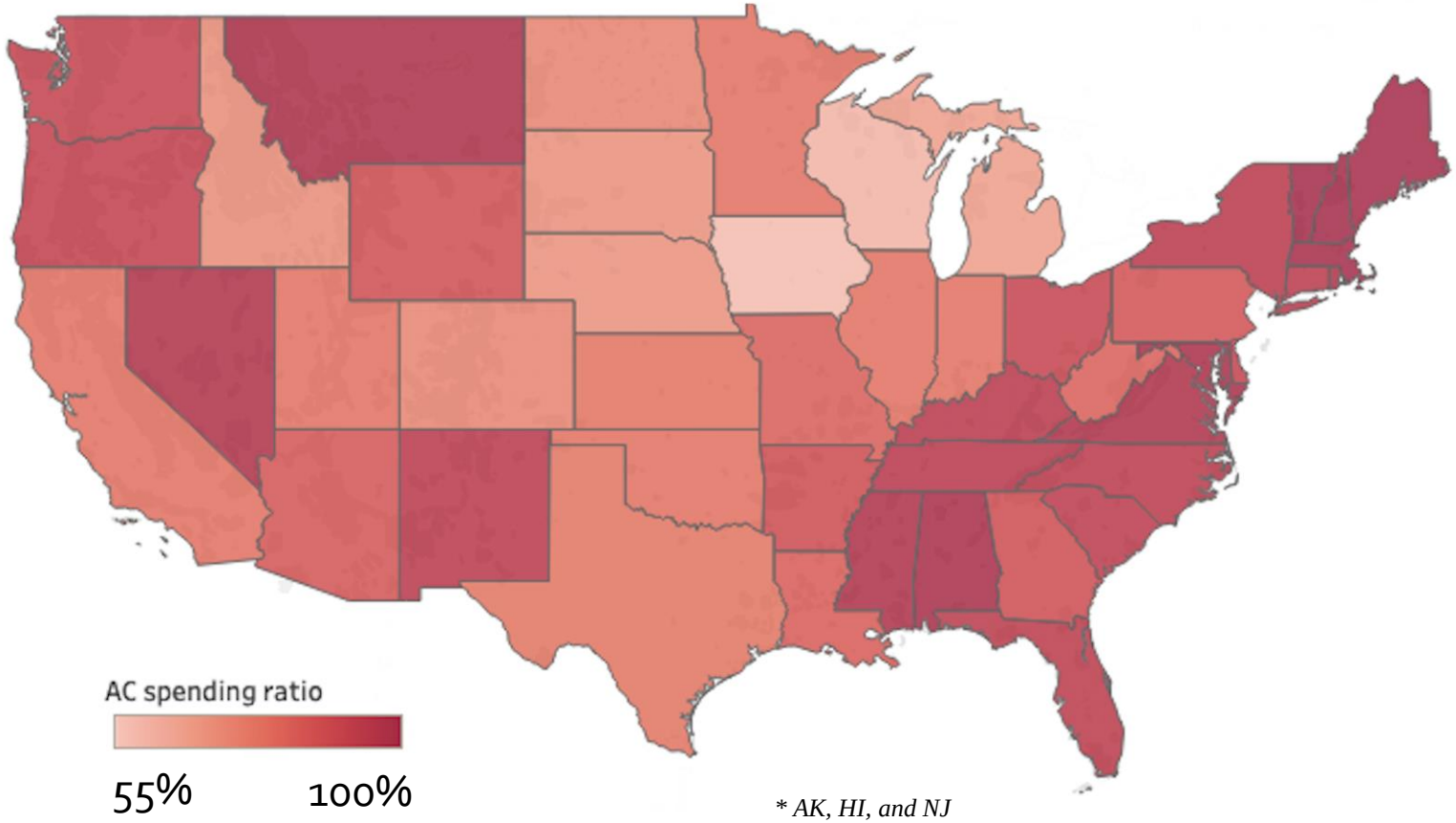


Contractor competition does not assure competition takes place at all levels of the supply chain

THERE ARE LIMITED OPPORTUNITIES FOR COMPETITION BETWEEN ASPHALT & CONCRETE IN MANY STATES

Most State DOTs spend most of their paving expenditures on Asphalt

10-Year Average Percent Spending on AC



** AK, HI, and NJ do not input pay item details.*

MIT 2020, https://cshub.mit.edu/sites/default/files/images/0315%20New%20Competition%20Summary.pdf

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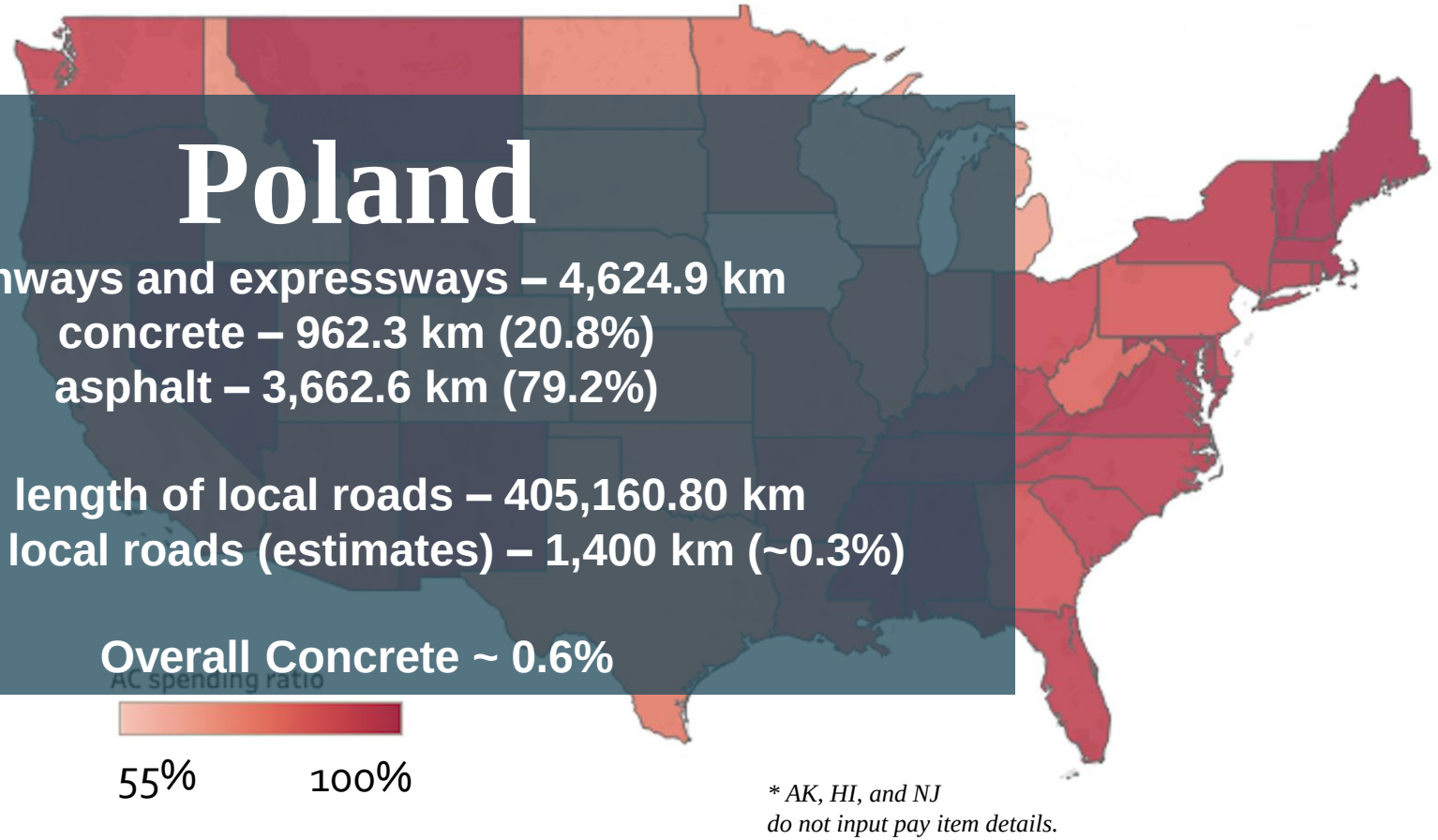

Poland

Highways and expressways – 4,624.9 km
concrete – 962.3 km (20.8%)
asphalt – 3,662.6 km (79.2%)

Total length of local roads – 405,160.80 km
concrete local roads (estimates) – 1,400 km (~0.3%)

Overall Concrete ~ 0.6%

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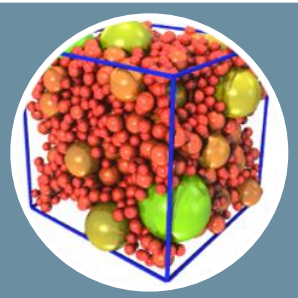
MIT CONCRETE SUSTAINABILITY HUB (CSHub)

Multi-year Project to Develop Breakthroughs that will Lead to More Sustainable and Durable Pavements and Buildings (http://cshub.mit.edu/)



Concrete Science

Mechanical & chemical models across length scales

Engineering

Improving the design process for pavements & buildings

Economics

Assessing financial risk of pavement & building investments

Environment

Assessing the environmental impact of pavements & buildings

Research approach holistic and multidisciplinary

The Goal of the research to lead to improved decision making

(1) providing scientific basis for informed decisions; (2) demonstrating the benefits of a life-cycle view; and (3) transferring research into practice.

QUESTION: DOES PAVING INDUSTRY COMPETITION CREATE SAVINGS FOR TRANSPORTATION AGENCIES?

MIT Analyzed 10 Years (2005-2014) of Pavement & Materials Pricing Data

- **Represented ~ 30,000 jobs.**
  - **Filtered to include only asphalt or concrete material pay items**
  - **Excluded activities that were not asphalt or concrete paving items (e.g., curbs, drainage, etc.)**
    - **73% of the asphalt pay items (94% of the asphalt spending)**
    - **57% of the concrete pay items (88% of the concrete spending)**

Slide Courtesy of MIT,
Source: Oman Systems, Inc Bid Tabulation Data. Retrieved from http://www.omansystems.com

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- Developed statistical models to determine what factors had significant influence on paving costs:
  - Quantity / Project Size
  - Annual spending
  - Number of bidders
  - Share/number of AC and PCC bids
  - Price Adjustment Clauses
  - Share of spending on AC vs. PCC

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INTER-INDUSTRY COMPETITION IMPACT IS LARGE

1st and 2nd Most Important Factor on Unit Costs for Concrete and Asphalt Paving

Significant factors

The wider the bar, the greater the impact

Project size:
volume of paving material used in job

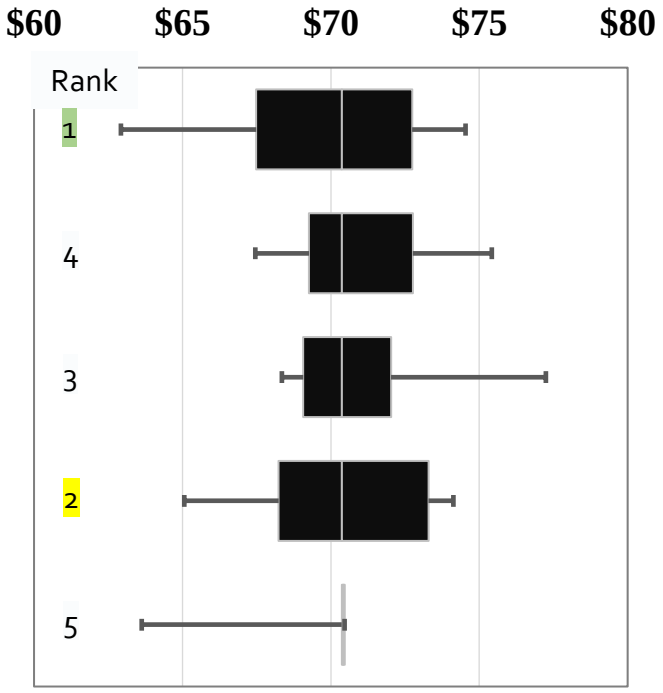
State market size:
annual spending on paving

No. of bidders on a job:
Intra-Industry Competition (Same industry)

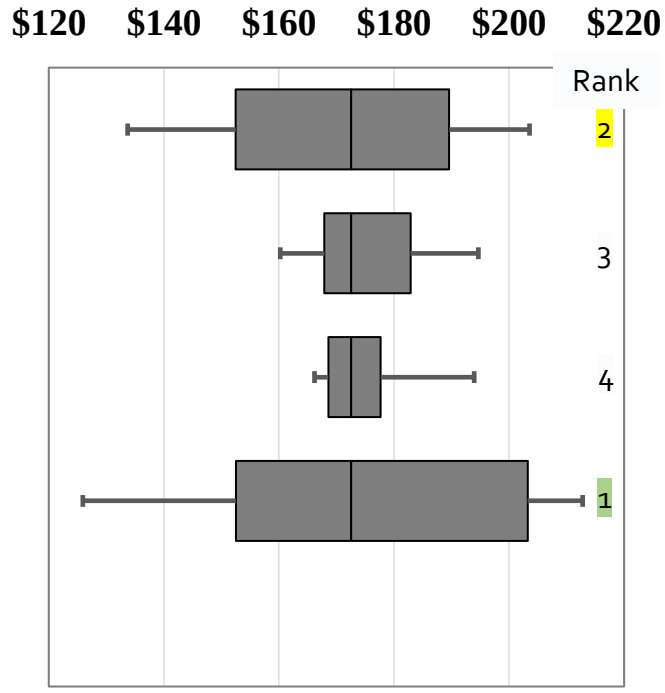
Dominant market share:
Inter-industry competition

Price adjustment clauses:
Asphalt PAC used in a state to allow contractors to adjust prices after the initial bid

Impact on Asphalt Prices ($/ton)



Impact on Concrete Prices ($/CY)



Competition between material industries has a larger impact than competition between multiple contractors

Slide Courtesy of MIT,

1 Indicates highest impact factor in paving costs

2 Indicates 2nd highest impact factor on paving costs

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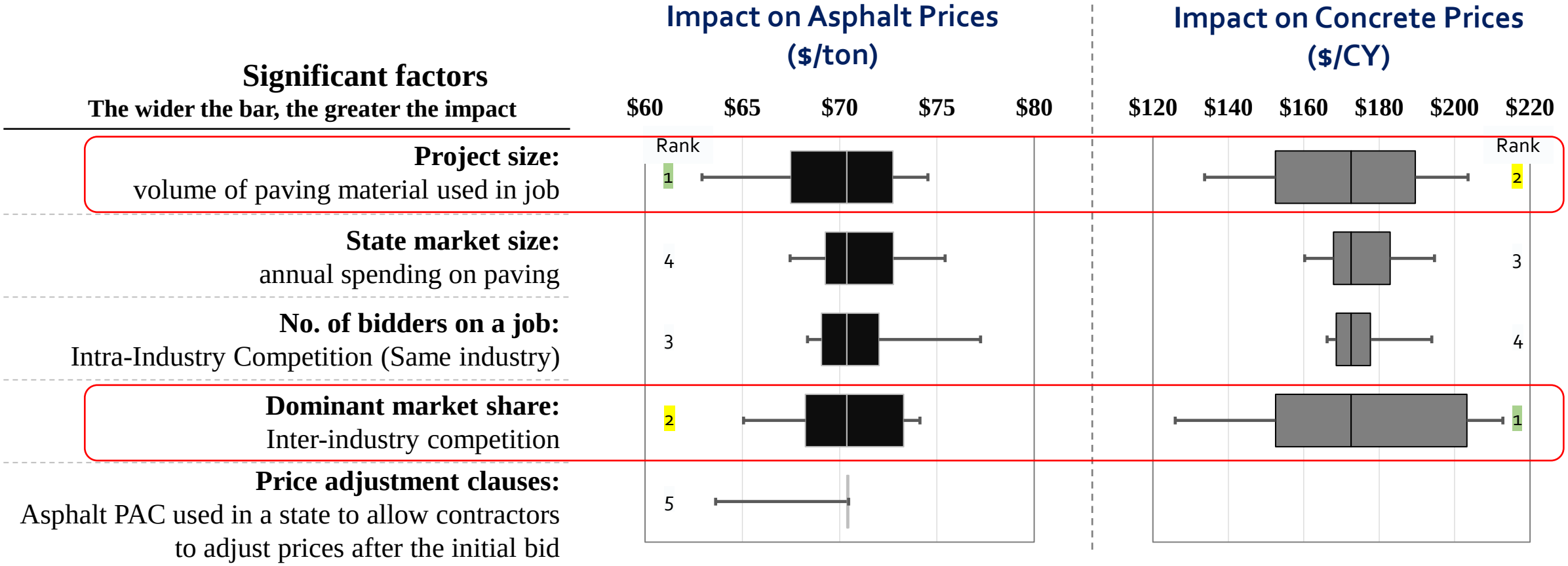

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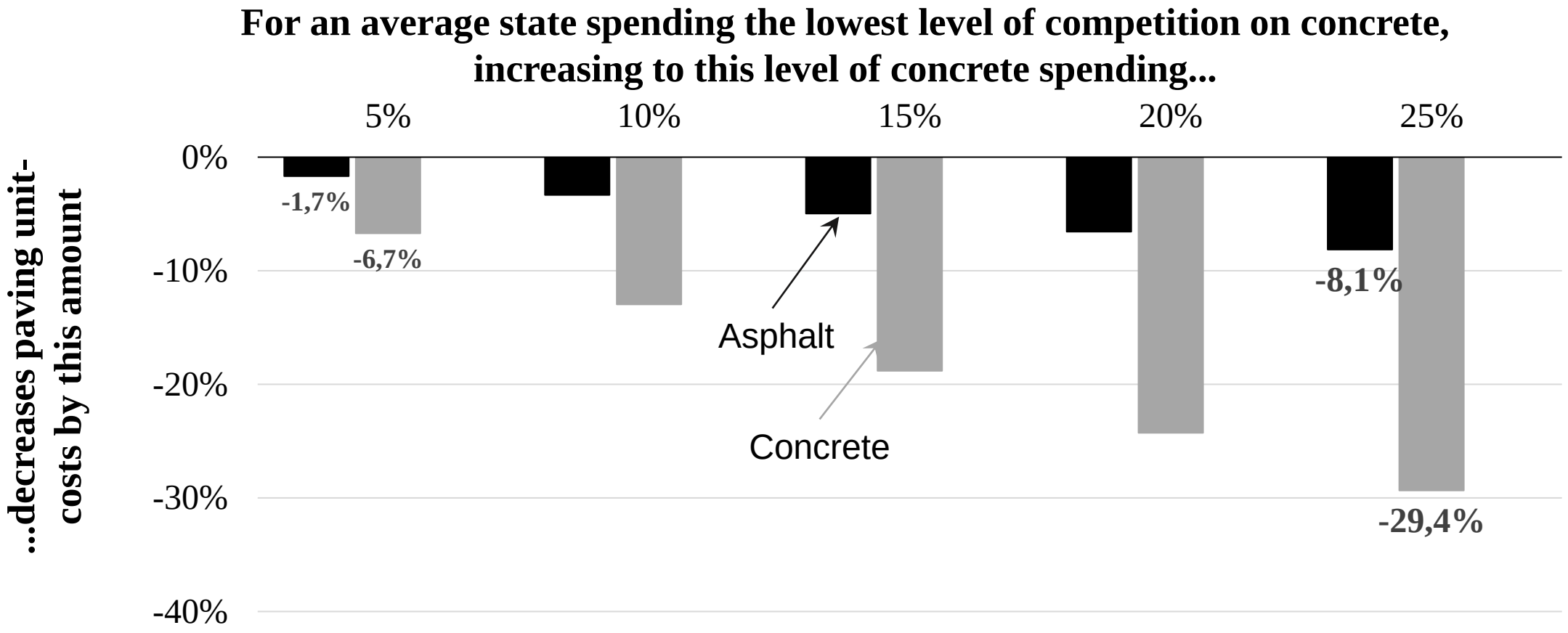
INTER-INDUSTRY COMPETITION LOWERS UNIT COSTS

Allows Highway Agencies to do More with their Budgets



States with high industry competition pay ~ 8% and 29% less for asphalt and concrete pavements respectively vs. states with the low competition (increasing competition between contractors only lowers cost ~ 5%)

Slide Courtesy of MIT,
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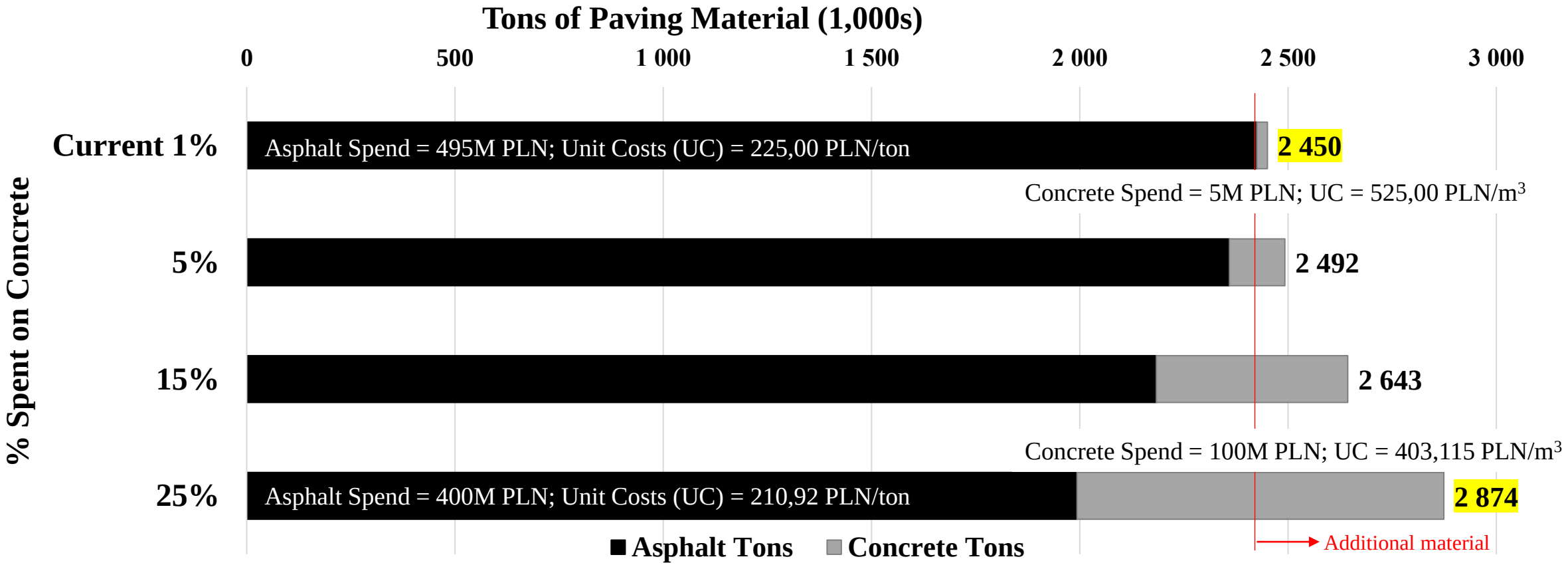
AGENCIES WITH A HEALTHY TWO-PAVEMENT SYSTEM CAN GET MORE "BANG FOR THE BUCK"

Long Term

Example: Agency Pavement Budget = $500M PLN (~$102M USD)

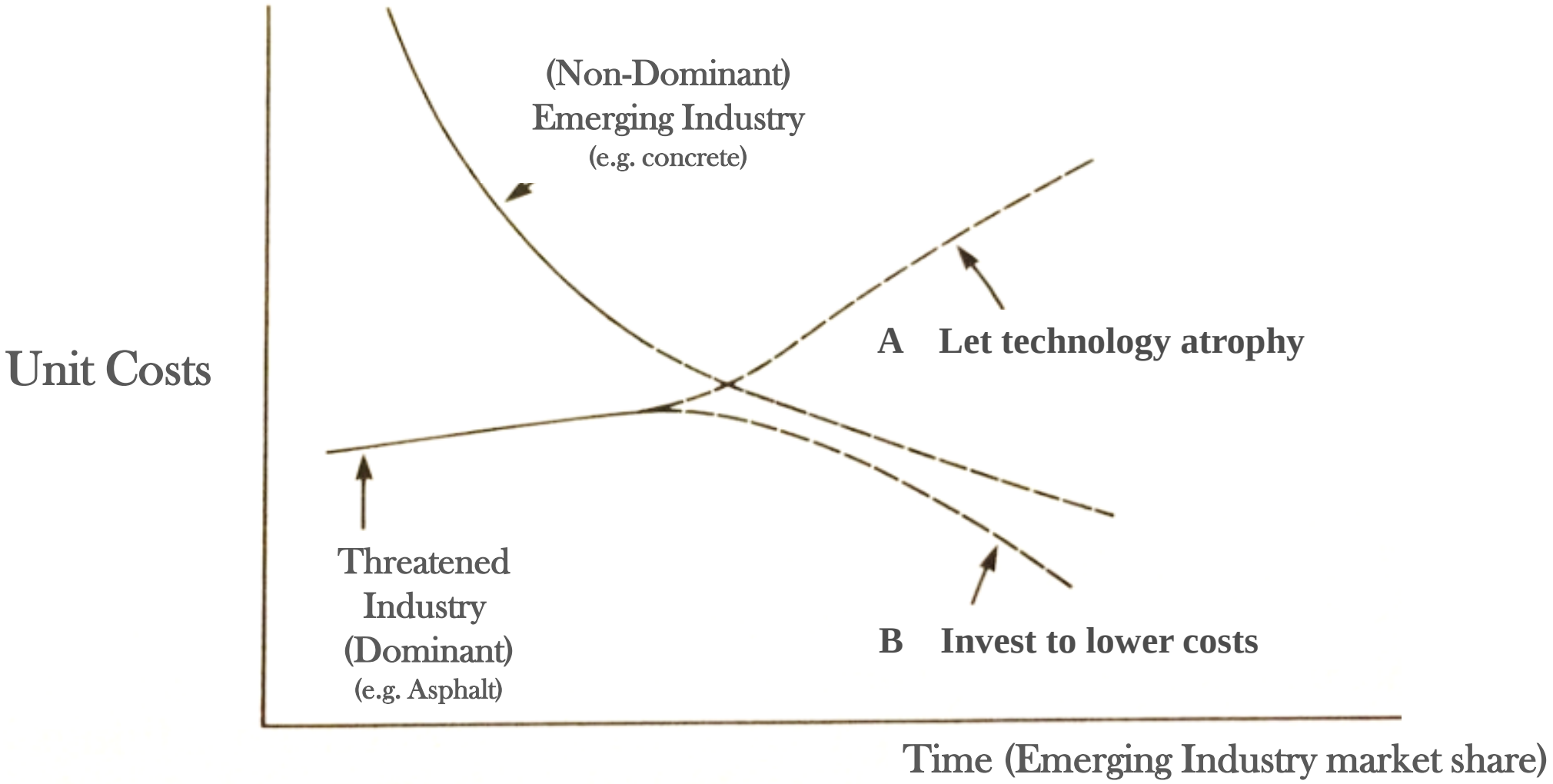


By marginally decreasing the purchases of asphalt tons, Poland has the opportunity to purchase 17% more paving materials with the same 500 million PLN

Based on $1USD = 4.99 PLN

COMPETITION THEORY THRESHOLD & PRICE IMPACT

Competitive Strategy in Emerging Industries



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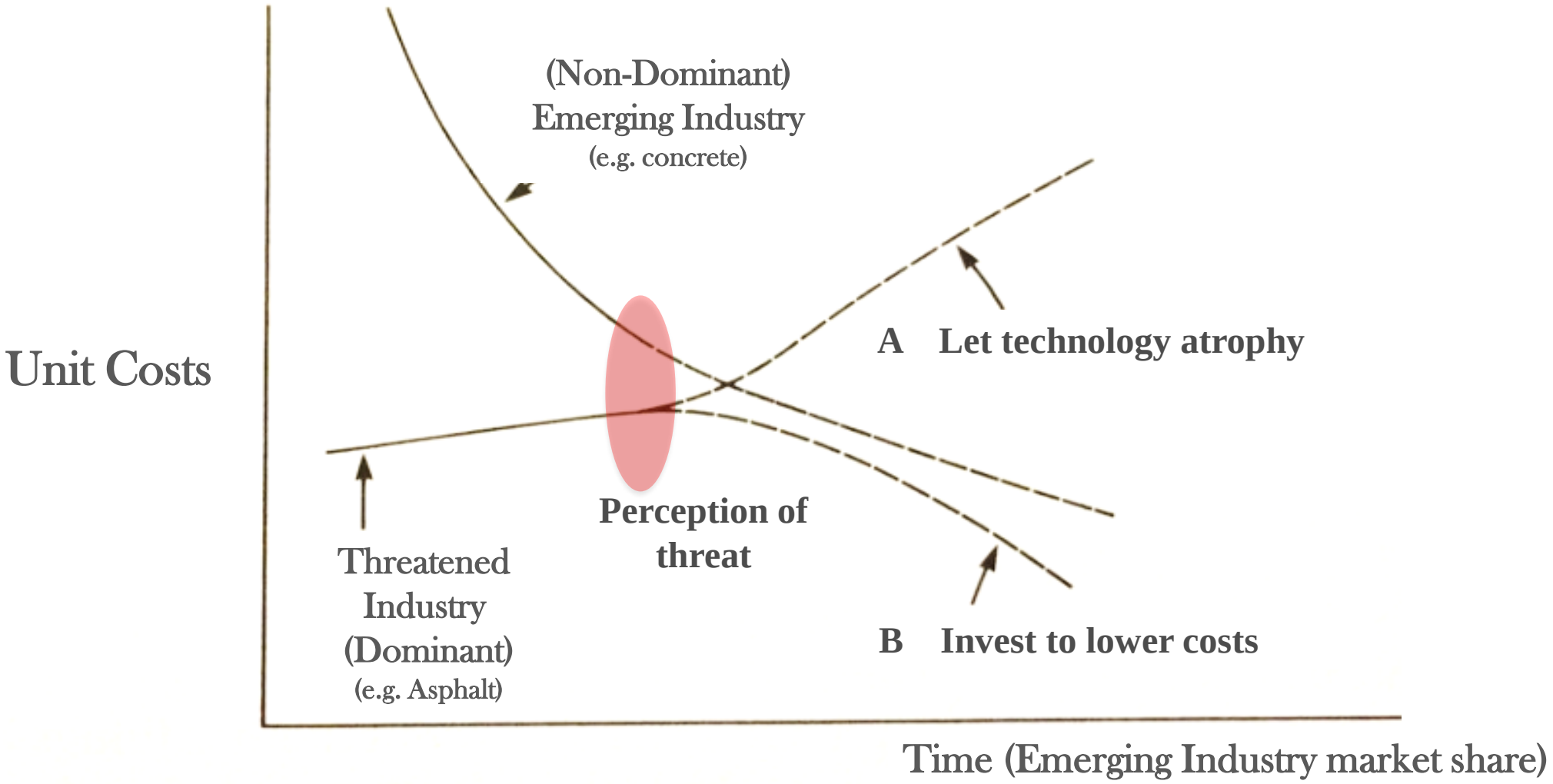

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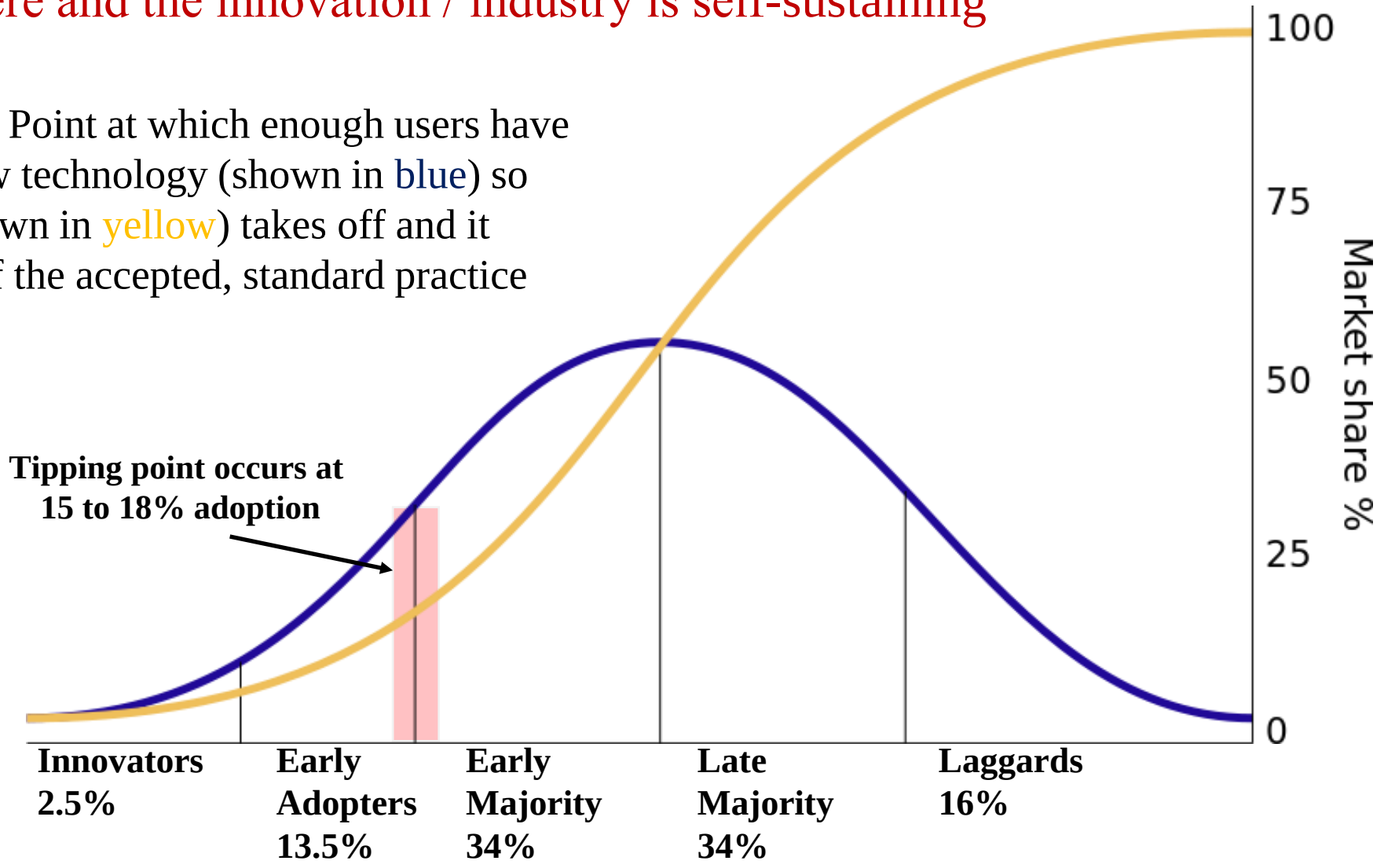
ADOPTION CURVE FOR INNOVATIONS

When the number of adopters reach the tipping point, the "Threat" is there and the innovation / industry is self-sustaining

Tipping point = Point at which enough users have adopted the new technology (shown in blue) so that its use (shown in yellow) takes off and it becomes part of the accepted, standard practice



Source: Everett Rogers' *Diffusion of Innovations* (Rogers, 2003)
https://en.wikipedia.org/wiki/Diffusion_of_innovations

TRANSPORTATION AGENCIES CAN CREATE OPPORTUNITIES FOR INDUSTRIES TO COMPETE

Transportation agencies often try these methods to impact Pavement Competition

Life-Cycle Cost Analysis (LCCA)	• An economic analysis tool that quantifies the differential costs of alternative investment options for a given project • LCCA determines which pavement design is most cost effective over the analysis period

Alternate Pavement Bidding (APB)	• Alternate Pavement Bidding is a Procurement process to in which both concrete and asphalt pavements are options
	  • Alternate pavement designs (asphalt and concrete) are developed for a project
	  • The contractor then chooses which material to submit for his bid
	  • Low bid – after life cycle adjustment – wins the project

LCCA and APB by Themselves Do Not Create a Competitive Environment

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Issues

1. Agencies don't know what are realistic costs for concrete pavement
2. Concrete industry does not invest in equipment, training, etc. because no certainty of future jobs
3. Asphalt is not threatened

LCCA and APB by Themselves Do <u>Not</u> Create a Competitive Environment

EXAMPLE: NOT KNOWING BID PRICES

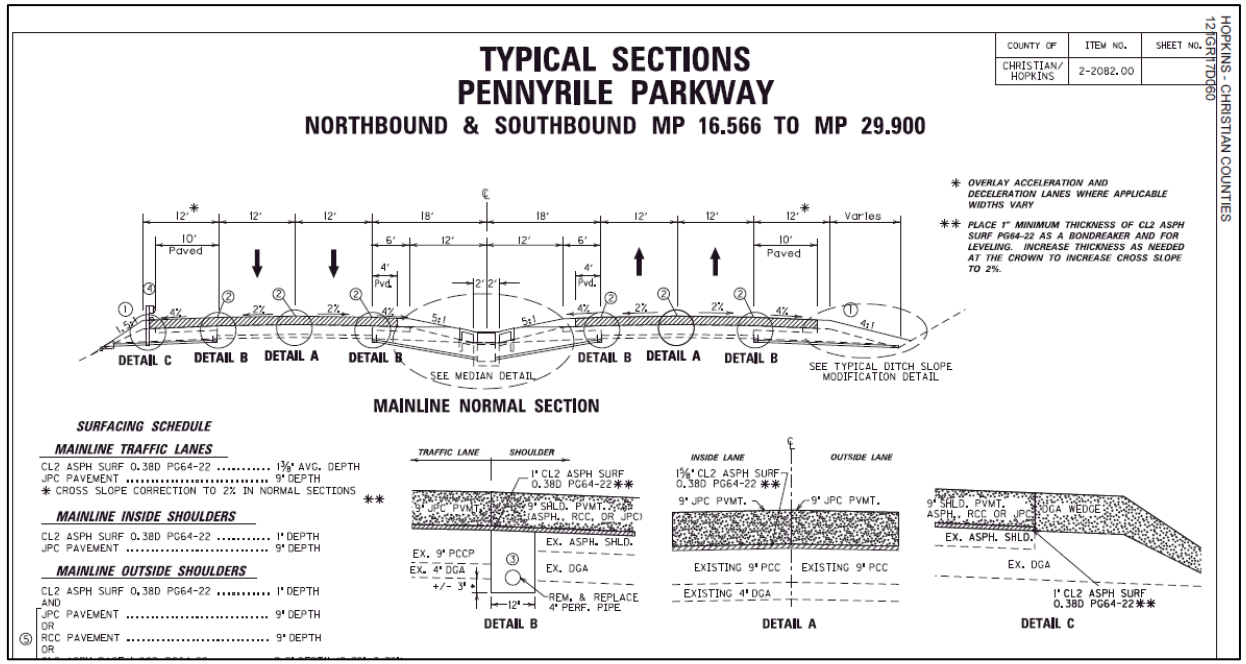
Kentucky Concrete Overlay Bid Results for Pennyrile Parkway: A 13.3 mile project using a 9-inch concrete overlay of an existing 4-lane concrete pavement

Bid in December (December 8, 2017)

KY Engineer's estimate = $52 M

Winning bid = $43.2M (16.9% below estimate)

If KY had used the $52M estimate in the LCCA to determine pavement type, they would not have bid concrete or created "competition."



Agencies need to bid concrete on a consistent basis in order to know what true costs are

STEPS TO CREATE A PAVING PROGRAM WHERE BOTH INDUSTRIES CAN COMPETE

Signals that the agency is serious about creating competition between industries

1. Transportation Agency announces their intention to have a concrete paving program

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Signals that the agency is serious about creating competition between industries

1. Transportation Agency announces their intention to have a concrete paving program
2. Agency adopts and uses all cement based / concrete solutions in multiple market applications
   - New Concrete Pavement, Concrete Overlays, Roller Compacted Concrete, etc
   - Interstates, State Highways, Rural roads, Intersections and Ramps
     - Creates multiple opportunities for potential concrete projects

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3. Agency purposely lets a given number of concrete projects each year and develops a Project Pipeline that covers several years

METHODS FOR DEVELOPING A PROJECT PIPELINE

Examples of how US States have Ensured both the Concrete and Asphalt Industry Participate

I. Designate a certain number of projects will be Concrete.
- Florida DOT – 10% of new roads (~40 miles/65 km) are concrete pavement / year.
- TxDOT – Consistently bids ~ 5M sy^2 (4.1M m^2) of concrete every year

II. Programmatically balance the market based on some metric such as volumes.
- Wisconsin & Michigan DOT – Balances their program to the same volume each year
  - Tons of asphalt ≈ square yards of concrete pavement

III. Use Traffic or road classifications to designate specific markets for each product.
- Minnesota DOT – based on Equivalent Single Axle Load (ESAL))
  - ESAL < 1 Million = Asphalt
  - ESAL > 7 Million = Concrete
  - Between 1 and 7 Million – go thru LCCA process
- Iowa DOT – Interstates = Concrete

Goals is to develop a "Program of Projects" vs a series of "Individual Projects"

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4. Agency develops Technical Task Forces to address issues with specifications, design procedures, and other policy / design / construction issues
   - There will be issues with design, construction, specifications, etc.
   - Task forces give the opportunity for industry and DOT come to a mutually agreeable solution that meets both groups needs
     - Lowers costs for future projects

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5. Use Life Cycle Cost Analysis and Alternate Pavement Bidding on Specific Pavement Projects

Only after agencies set the groundwork for an Inter-Industry Competitive Pavement Environment can LCCA and APB be used to lower costs even further on specific projects

SUMMARY

Transportation agencies need to find ways to maximize their limited infrastructure funding

Increasing inter-industry competition (competition between firms that pave with different pavement material substitutes) can lower pavement Costs

- Brings additional contractors
- Brings another level of competition to the supply chain

MIT Research shows that U.S. States with highest level of competition between the asphalt and concrete industries pay 8% and 29% less for their asphalt and concrete, respectively, than states with the lowest level of competition.

- Increasing intra-industry (same material) competition only reduces costs for an "average" project by 3%.

Agencies should <u>proactively pursue</u> policies that increase inter-industry competition, which will over time significantly lower unit cost for both paving materials

THANK YOU

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