QPL Complexity Vs Product Innovation

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Starting a Conversation

1. "Innovation Survey" results
2. Measurement of the complexity for QPL/APL DOT product approval
3. What complexity means for the bridge preservation industry
4. Potential alternatives to current status quo

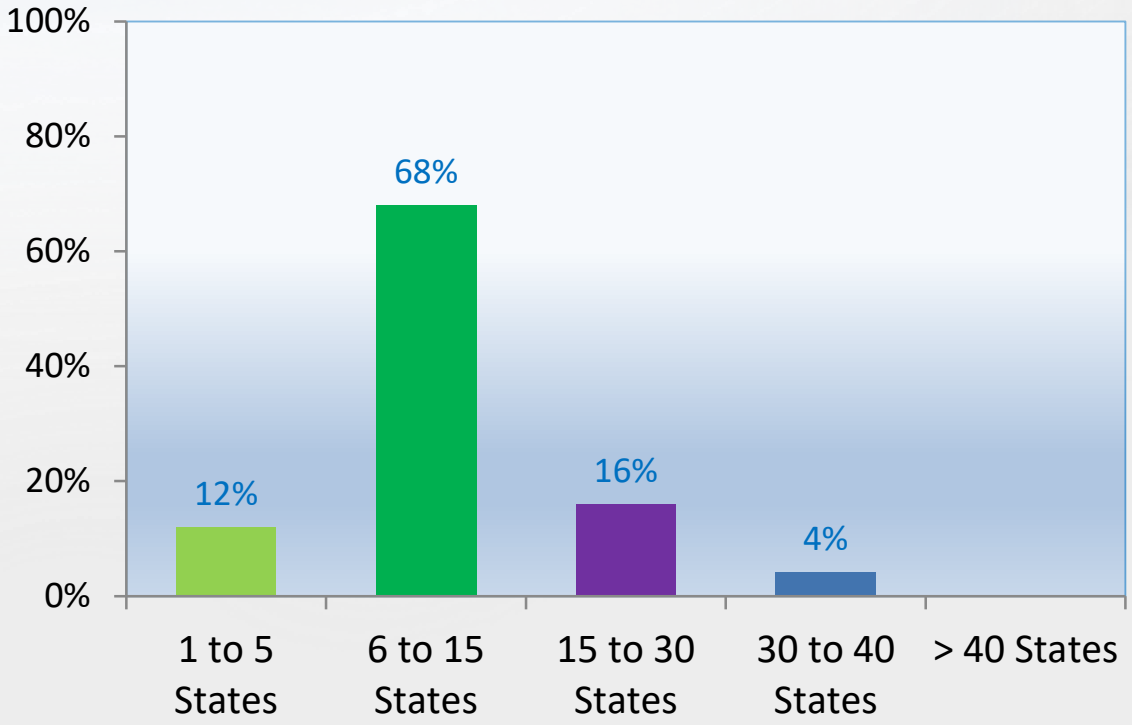
2014 Innovation Survey by FHWA BPETG

BASF Construction Systems	Phoscrete Corporation
CentriPipe - AP/M	RJ Watson
CeraTech	RPM - Alteco Polymers
ChemMasters	Sika
Cortec Corporation	Simpson Strong-tie
CTS Cement Manufacturing	Termarust Technologies
D.S. Brown Company	Transpo Industries
E-Bond Epoxies	Unitex - Dayton Superior
Evonik	Vector Corrosion Technologies
Fyfe Company	Wasser Corporation
Kaufman Products	Watson Bowman Acme
Kwik Bond Polymers	Willamette Valley Company
Liquid Concrete	

25 Manufacturers participated in the Innovation Survey that was conducted in 2014 by the FHWA Bridge Preservation Expert Task Force Group.

Goal of the Survey: "To understand challenges faced by product manufacturers in developing and launching new, innovative products for bridge preservation".

Number of Targeted States



80 % (68 %+ 12%) of Manufacturers target less than one-third of US States when launching a new product.

None target the entire US market with a new product.

Limited expectations for sales by Manufacturers

Manufacturers' Limited Expectations

- Manufacturers may limit R&D investments in product innovation for bridge preservation
- Manufacturers tend to release to the market products they already have
- Manufacturers tend to choose the most lucrative States or regional areas
- Many States, especially the small ones, may not be exposed to the use of innovative products

Why "Limited Expectations"?

Complexity

Complexity of DOT Product Approval in the 50 US States

Measurement of QPL/APL test requirements for DOT approval of an ordinary product: the "*Fast Set Concrete Repair Patch*".

The *Fast Set Concrete Repair Patch*


Courtesy of Phoscrete


Courtesy of Phoscrete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Alabama DOT	Patching Material for Portland Cement Concrete
Alaska DOT	Joint and Patching Materials for Concrete
Arizona DOT	Portland Cement Concrete Pavement (PCCP) Patching – Rapid Setting Patch Material
Arkansas DOT	Portland Cement Concrete Pavement Patching
Caltrans	Fast-Setting Concrete
Colorado DOT	Concrete\Repair/Patching - Rapid Set Horizontal
Connecticut DOT	Partial Depth Patch
Delaware DOT	Patching PCC Pavement, High Early Strength
Florida DOT	Materials for Repair of Predominately Horizontal Surfaces - 930-4.2.2 Very Rapid Hardening
Georgia DOT	Rapid Setting Patching Material
Idaho DOT	Rapid-setting, Concrete Patching Material
Illinois DOT	Packaged, Dry, Rapid Hardening Cementitious Materials for Concrete Repairs" R3 Mortars
Indiana DOT	Rapid Setting Patch Materials
Iowa DOT	Patch Material - Rapid Set Concrete
Kansas DOT	Rapid-Set Concrete Patching Material
Kentucky DOT	"Very Rapid" Hardening Repair Patch
Louisiana DOT	Rapid Setting Patching Material for Concrete
Massachusetts DOT	Rapid Set Concrete Patch Materials (Horizontal Fast Set)
Maine DOT	Fast Setting Concrete Patching Materials
Maryland DOT	Rapid Hardening Cement (horizontal repairs)
Michigan DOT	Pre-packaged Hydraulic Fast Set Mortar
Minnesota DOT	Rapid Hardening Materials for Repairs
Mississippi DOT	Rapid Set Concrete Patching Compounds.
Missouri DOT	Rapid Set Concrete JSP-02-10
Nebraska DOT	Construction Products - Concrete - Pavement and Structural Patching Materials – Horizontal Placements
Nevada DOT	Fast Setting Concrete Products - Non Structural - Spec 609.02.01a
New Hampshire DOT	Rapid Hardening Patching Material
New Jersey DOT	Quick-Setting Patch Materials Type 1
New York DOT	Rapid Hardening Concrete Repair Material (Normal Weather)
New Mexico DOT	Concrete Structure Repair - Enriched Mortar
North Carolina DOT	Repair Materials: Concrete
Ohio DOT	Quick Set Concrete Mortar
Oklahoma DOT	Portland Cement Concrete Patching Material
Oregon DOT	PCC Repair, Very Rapid Setting
Pennsylvania DOT	Rapid Set Concrete Patching Materials
Rhode Island DOT	Patching Mortar
South Carolina DOT	Rapid Patch Material for Concrete Pavement
Sounth Dakota DOT	Concrete Patch Material
Tennessee DOT	Rapid Set Cementitious Patching Materials
Texas DOT	Concrete Repair Materials - Ultra-Rapid Repair Materials
Utah DOT	Structural Pothole Patching
Vermont DOT	Rapid Setting Concrete Repair Material
Virginia DOT	Packaged Materials to be Used in Concrete Repairs
Washington DOT	Bridge Deck Repair Material
West Virginia DOT	Concrete Repair Materials
Wisconsin DOT	Rapid Set Concrete Patch Materials
Wyoming DOT	Horizontal Repair Material

40 States: QPL/APL
7 States (yellow): Standard Specifications
3 States: No Category/Spec.

7 Most Popular Tests

Spec.	Description	N. of Agencies
ASTM C109	Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens)	35
ASTM C157	Length Change of Hardened Hydraulic-Cement Mortar and Concrete	35
ASTM C882	Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear	32
ASTM C143	Slump of Hydraulic-Cement Concrete	23
ASTM C230	Flow Table for Use in Tests of Hydraulic Cement	23
ASTM C 928	*Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs*	22
ASTM C666	Resistance of Concrete to Rapid Freezing and Thawing (Proc. A or B or both)	17

7 Tests are Required by >15 DOT Agencies

ASTM C928 includes: C109, C143, C157, C230, C882 – ASTM C666 counts as 2 Tests

4 Additional Popular Tests + NTPEP

Spec.	Description	N. of Agencies
ASTM C39	Compressive Strength of Cylindrical Concrete Specimens	9
ASTM C266	Time of Setting of Hydraulic-Cement Paste by Gillmore Needles	7
AASHTO T260	Chloride Ion in Concrete	6
ASTM C531	Linear Shrinkage and Coefficient of Thermal Expansion	5
NTPEP	Rapid Set Concrete Patch Materials (RSCP)	15

4 Tests are Required by >5 DOT Agencies

NTPEP is requested by 15 DOT Agencies.

In no case NTPEP is the sole condition for approval. It is considered as an additional documentation.

11 Marginal Tests

Spec.	Description	N. Agencies
ASTM C403	Time of Setting of Concrete Mixtures by Penetration Resistance	4
ASTM C1202	Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration	4
ASTM C78	Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)	3
ASTM C1090	Changes in Height of Cylindrical Specimens of Hydraulic-Cement Grout	3
AASHTO T260	Chloride Permeability	2
ASTM C191	Time of Setting of Hydraulic Cement by Vicat Needle	2
ASTM C469	Modulus of Elasticity in Compression	2
ASTM C596	Drying Shrinkage of Mortar Containing Hydraulic Cement	2
ASTM C672	Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals	2
ASTM C1152	Acid-Soluble Chloride Ion Content in Mortar and Concrete	2
ASTM C1218	Water Soluble Chloride Ion Content in Mortar and Concrete	2

7 Very Marginal Tests

Spec.	Description	N. Agencies
AASHTO T105-15.1	Sulphate Content	1
ASTM C496	Splitting Tensile Strength of Cylindrical Concrete Specimens	1
ASTM C642	Density, Absorption, and Voids in Hardened Concrete	1
ASTM C807	Time of Setting of Hydraulic Cement Mortar by Modified Vicat Needle	1
ASTM C1042	Bond Strength of Latex Systems Used With Concrete By Slant Shear	1
ASTM C1583	Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)	1
ASTM C127	Relative Density (Specific Gravity) and Absorption of Coarse Aggregate Modified	1

7+4+11+7=28 Tests
This does not take into consideration the modifications

Test Modifications for ASTM C666

Michigan DOT	12 freeze-thaw cycles while ponded with fresh water. 24 freeze-thaw cycles while ponded with a 3% solution of NaCl 12 freeze-thaw cycles while ponded with fresh water
NYSDOT	Immediately after weighing the specimens are replaced in the original receptacles in the 10% NaCl solution, and placed in the chamber maintained at a temperature of -10 f 5°1. The receptacles remain in the chamber until the brine solution is completely and solidly frozen and the internal temperature of the specimen reaches -10 f 5°1.
Vermont DOT	AASHTO T161 using Procedure A (Modified) for use of a 3% Sodium Chloride solution.
PennDOT	Resistance of 50 mm x 50 mm (2" x 2") cube specimens of mortar to alternate freezing and thawing while immersed in a brine of 10% by mass Calcium Chloride in water
Virginia DOT & Maryland DOT	Loss after 25 cycles of freezing and thawing in 10% Calcium Chloride solution

18 Test Modifications

Spec	N. Modifications	Spec	N. Modifications
ASTM C666	5	AASHTO T260 Chloride Permeability	1
ASTM C882	3	ASTM C143	1
ASTM C109	2	ASTM C531	1
ASTM 157	2	ASTM C672	1
		ASTM C1202	1
		ASTM C1218	1

18 modifications are requested (19 if C127 is included)
Number of tests rises from 28 to 46

10 Custom DOT Tests

Spec.	Description	Agency
Arizona Shear Test	Bond Strength	New Jersey DOT
California Test 417	Testing Soils and Waters for Sulfate Content	Caltrans
California Test 422	Testing Soils and Waters for Chloride Content	Caltrans
California Test 550	Surface Abrasion Resistance of Concrete Specimens	Caltrans
California Test 551	Suitability of Materials for Overlayment and Repair (…)	Caltrans
California Test 553	Thermal Stability of Mortar Made with Hydraulic Cement	Caltrans
FM5-516	Low-Levels of Chloride in Concrete and Raw Materials	Florida DOT
FM5-587	Bond Strength of Repair Materials with Concrete by Slant Shear	Florida DOT
MRD-3	Flexural Strength (…) using Simple Beam with Center Point Loading	Vermont DOT
Tex-428-A	Coefficient of Thermal Expansion of Concrete	Texas DOT

Total of 56 Tests (including State DOT Custom Tests) + NTPEP

Cost: "Strength" Tests

Test Specifications		N. Tests	Cost	Total
Compressive Strength	ASTM C39	1	$275	$1,070
	ASTM C109	3	$795	
Modulus Elasticity	ASTM C469	1	$375	$375
Tensile Strength	ASTM 496	1	$130	$130
Flexural Strength	ASTM C78	1	$438	$893
	VT MRD-3 - Vtrans	1	$455	
Bond Strength	ASTM C882	4	$4,720	$8,475
	ASTM C1042	1	$1,000	
	ASTM C1583	1	$700	
	Arizona Shear Test	1	$620	
	CT551	1	$1,000	
	FM 5-587	1	$435	
TOTAL				$10,943

In order to meet DOT requirements for bond strength alone, the manufacturer should carry out 9 different types of tests for a total cost of approx. $8,500

Cost: Fresh Properties & Volume Stability Tests

Test Specifications		N. Tests	Cost	Total
Workability	ASTM C143	2	$150	$948
	ASTM C191	1	$180	
	ASTM C230	1	$58	
	ASTM C266	1	$170	
	ASTM C403	1	$220	
	ASTM C807	1	$170	
Volume Change	ASTM C157	3	$1,867.5	$2,588
	ASTM C596	1	$600	
	ASTM C1090	1	$450	
Thermal Stability	ASTM C531	2	$967	$2,117
	CT553	1	$500	
	Tex-428-A	1	$650	
Absorption	ASTM C127	1	$185	$310
	ASTM C642	1	$125	
TOTAL				$5,952

6 different types of tests are requested for workability, a basic property that is measured either by slump or flow

Cost: Durability Tests

Test Specifications		N. Tests	Cost	Total
Durability	ASTM C666	7	$15,750	$16,492
	ASTM C672	1	$742	
Chloride Content	AASHTO T260	3	$480	$2,245
	ASTM C1152	1	$200	
	ASTM C1202	2	$925	
	ASTM C1218	2	$315	
	CT422	1	$200	
	FM 5-516	1	$125	
Sulphates	AASHTO T105	1	$150	$350
	CT 417	1	$200	
Abrasion	CT550	1	$900	$900
TOTAL				$19,987

To implement the 7 modifications of ASTM C666 costs approximately $16,000.
This raises the overall cost of durability tests

Summary of Costs

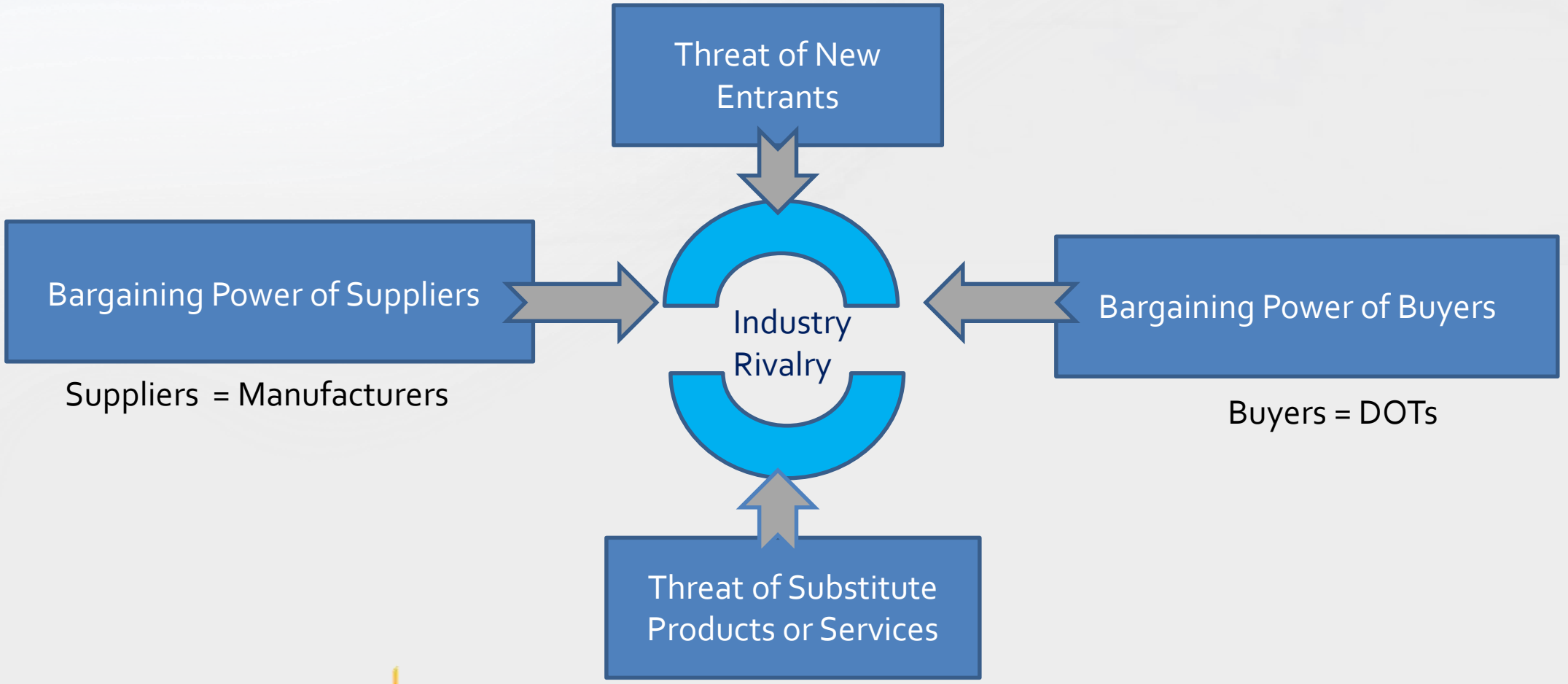
Set of Tests	Calculated Cost	Approx. Cost
Strength	$10,943	**$11,000**
Workability and Volume Stability	$5,962	**$6,000**
Durability	$19,987	**$20,000**
NTPEP		**$10,000**
Total Test Cost		**$47,000**
Management Fees (Lab & Manufacturer)		**$30,000**
TOTAL		**$77,000**

It roughly costs $47,000 to obtain the full set of tests that allows the submittal of a concrete patch repair material to QPL/APL at 40 DOT Agencies

An additional $30,000 can be estimated in order to be able to manage 56 tests with minor, yet significant, differences between them

DOT Agencies have set up a system that makes product approvals quite costly and complex.

Porter's 5 Forces



Suppliers = Manufacturers

Buyers = DOTs

Bargaining Power of DOTs is High

Power of Buyers

- DOTs are more concentrated than Manufacturers
- DOTs switching costs are low
- DOTs are price sensitive
- DOTs are well-educated regarding the product
- Substitutes are available
- DOTs purchases comprise large portion of Manufacturers' sales

Since the opposite is NOT true for these factors, **Manufacturers' Power is Low**.

Threat of New Entrants and Substitutes

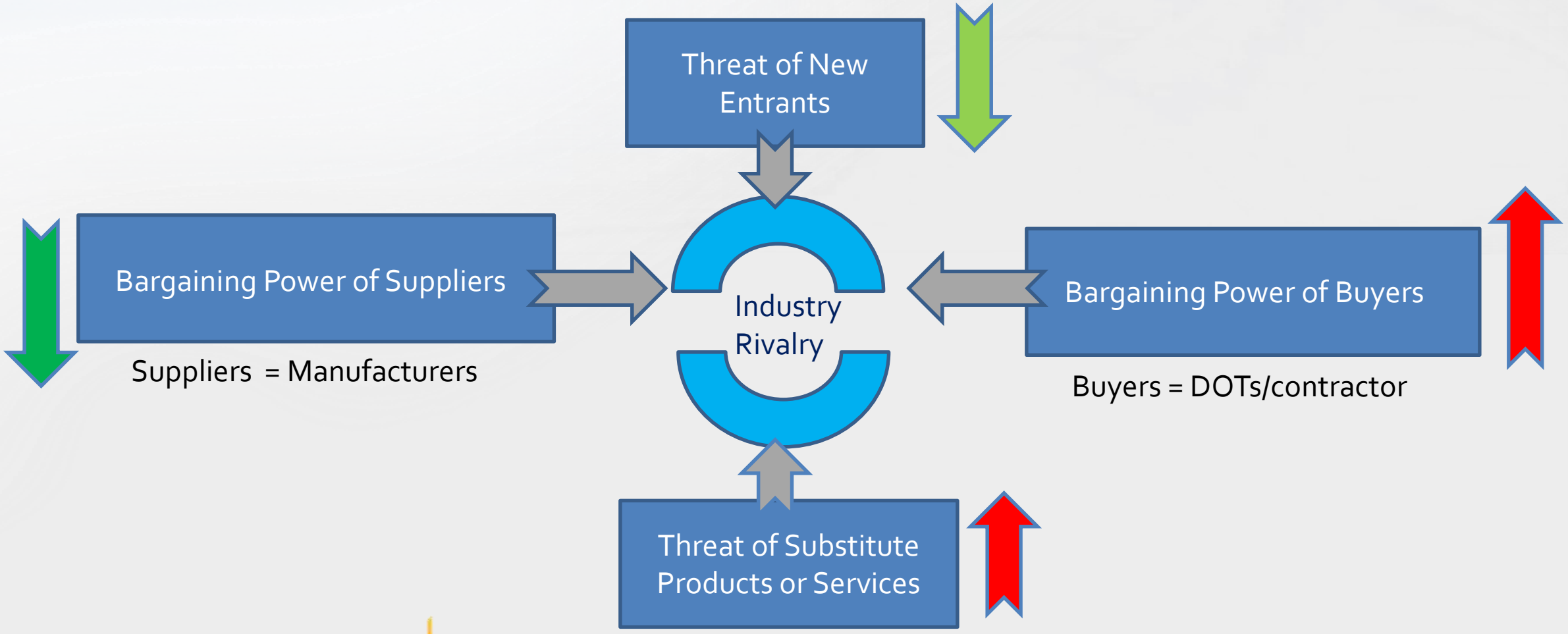
Threat of New Entrants is Low

- Initial investment for Manufacturers is high.
- Accessing distribution channels for Manufacturers is difficult.

Threat of Substitutes is High

- Replacing rather than repairing can be cheaper for large projects.
- Quality and performance of replacing is often considered superior to repair.

Porter's 5 Forces: A Model for Preservation



Industry Attractiveness

Get a discussion going…

- Is this an attractive industry?
- Is it an industry that favors innovations?

Being in the QPL/APL is just the beginning…

- Being all products equal, competition is based on price
- For large jobs, contractors choose lower cost products
- No rewarding system is in place for products that bring additional benefits that can save time/money

Suggested Solutions

- DOTs agree on Regional Specs
  - Reduces number of tests and modifications
- Expand NTPEP to include all DOT test requirements and fully endorse it
  - Reduces QPL/APL management cost by DOTs
- Create an independent avenue for innovative products that together with Lab tests also includes extensive field tests
  - AASHTO APEL, ITD (TSP2 Industry Technology Demonstration)
  - Keep as it is for existing products

Thank You!

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