



Optimizing Enterprise Road Asset Infrastructure with Data Analytics

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Your Toll Infrastructure is Deteriorating While You Sit Here Listening to Me

- Relentless wear and tear
- Very significant bottom-line capital and expense costs
- Infrastructure deterioration can be modeled and predicted
- Moving toward preventive maintenance and away from worst-first



Toll Infrastructure Investment Growth



- More than **\$14 billion** in capital investment was made over three years by the top 40 U.S. toll facilities
- The number of trips taken by drivers on tolls roads increased 14% over the last four years – from 5 billion trips in 2011 to **5.7 billion** in 2015
A lot of money goes into Tolling Infrastructure
- 9% increase in overall toll road mileage within the U.S., from 5,431 miles in 2011 to over **5,932 miles** as of 2013

Source: IBTTA & FHWA

Asset Management Regulations in Tolling

- U.S. legislation: ***Moving Ahead for Progress 21st Century*** (MAP-21) & ***Fixing America's Surface Transportation Act*** (FAST) allow selective tolling of Interstates
- Performance reporting
- Impact on toll infrastructure
- International public infrastructure condition requirements

MAP-21 Implications for Asset Managers

- Asset Management has taken Center Stage with MAP-21!
- Asset Management Systems are now eligible for federal funding
 - Most agencies are assessing existing systems & considering future needs
 - System integration is increasingly important
- Safety Data Management Systems are now required
- AMS knowledge and experience will be in great demand within transportation agencies. Influential Role!
- NHPP program management and project selection will have critical dependencies on Asset Management Systems
- Required Performance Metrics will drive need for enhanced tools for analyzing data and investment decisions, e.g. ATOA

What is Transportation Asset Management (TAM)?

- Strategic and systematic life-cycle process
- Focus on business and engineering practices
- Better decision making and budget management



Source: AASHTO Sub Committee on Asset Management

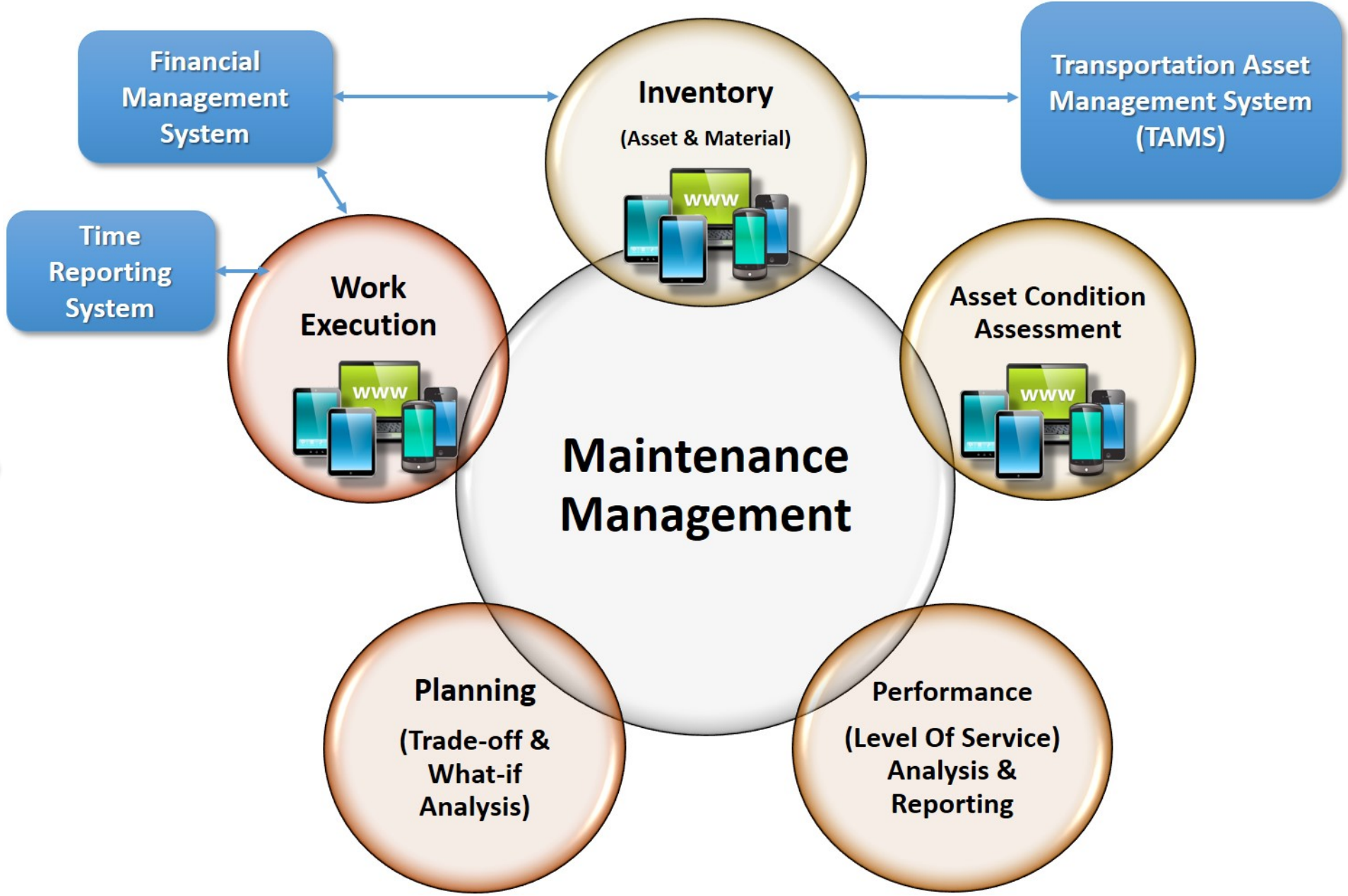
TAM Addresses 5 Core Questions



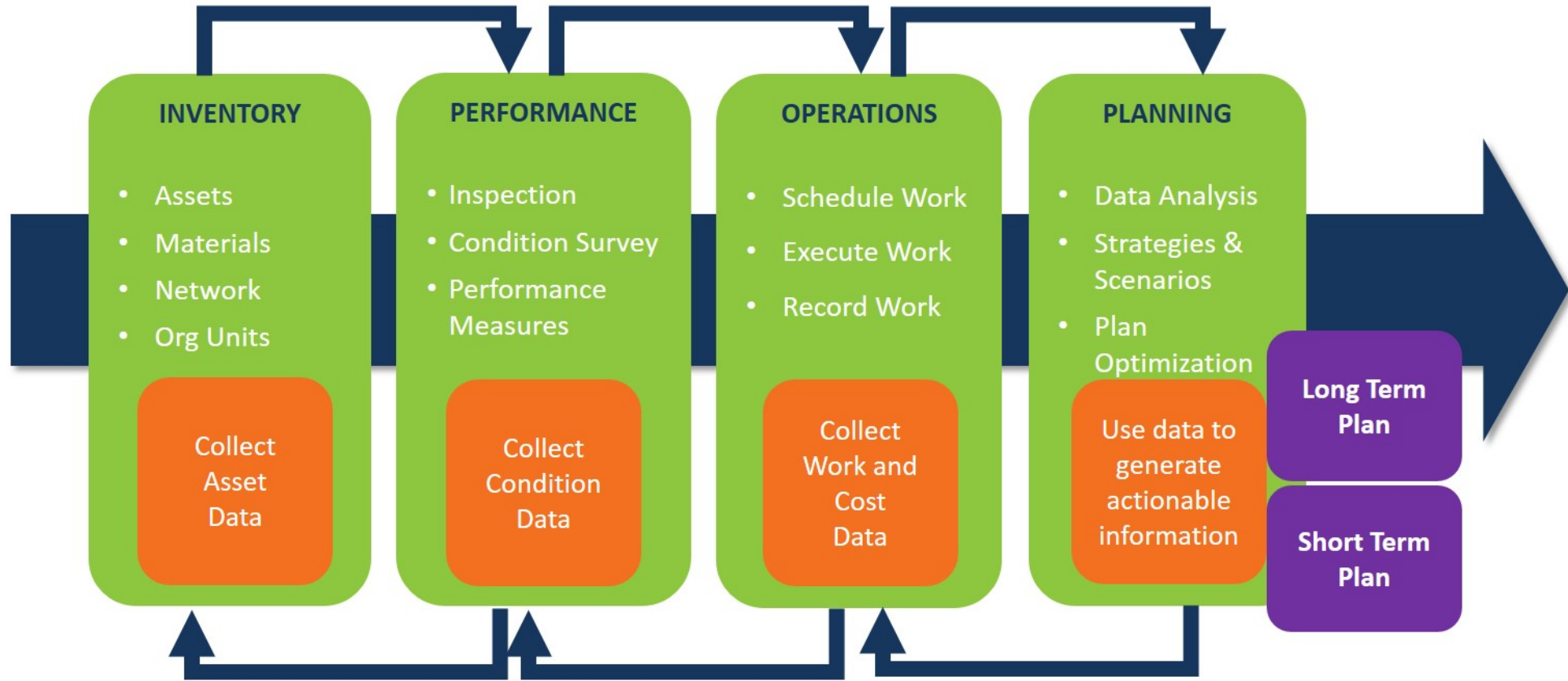
1. What is the current state of my assets?
2. What are my required levels of service and performance delivery?
3. Which assets are critical to sustained performance delivery?
4. What are my best investment strategies for operations, maintenance, replacements and improvement?
5. What is my best long-term funding strategy?

Source: Multi-sector Asset Management, Publication No. FHWA-HIF-09-022

Maintenance Management Life Cycle

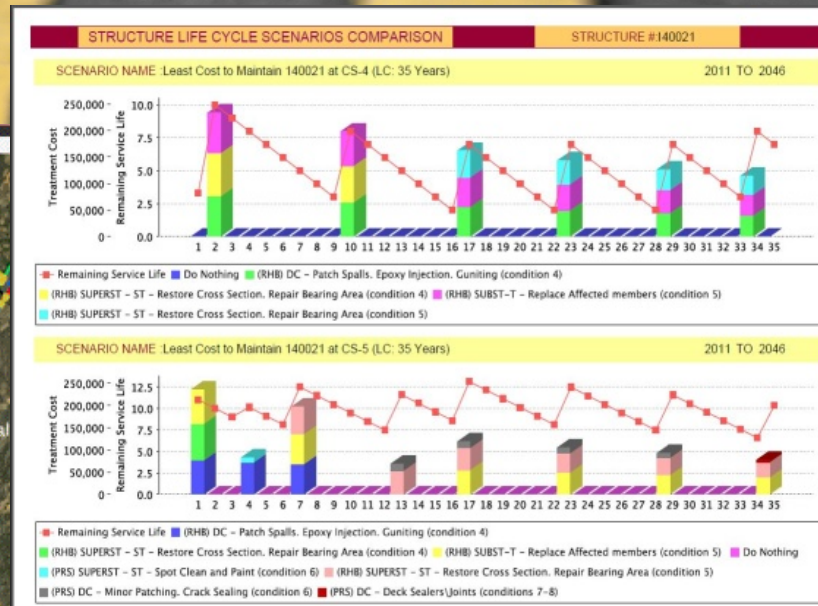
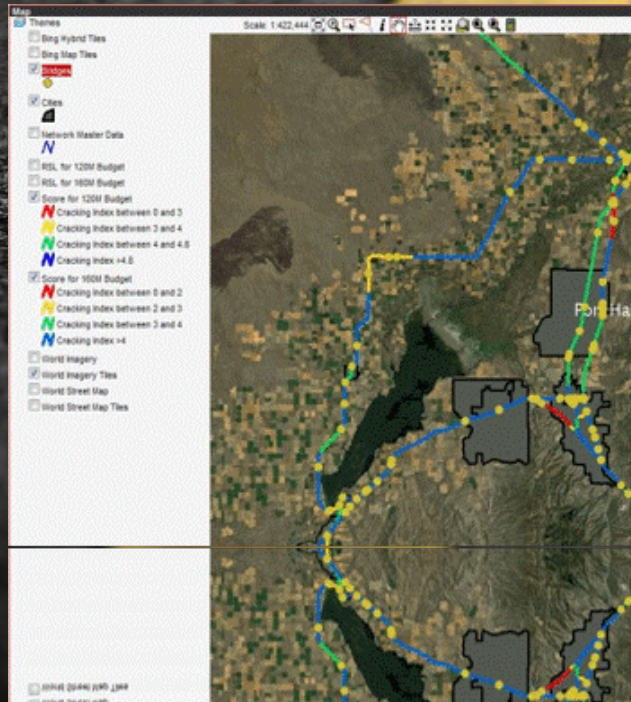


Iterative Asset Management Process



Toll Systems are Linear Assets

Increase Tolling Profits Through Technology



AgileAssets Management System

Database Performance Analysis Network Analysis Linear Network Tools Reports

Network Master Data

63 pages (1675 rows)

Line	Start MP	End MP	PRM Section #	Length	Asset Present Value	Section Width	Min Width	Avg Width	Number of Lanes	Y/C	District
AR	54.930	63.937	4542163	9.071	\$5,206,202.00	31	31	31	2	AC	3030 - 04
AR	65.022	71.307	4542156	6.285	\$1,242,144.00	32	32	32	2	AC	3030 - 04
AR	71.307	72.401	4543513	1.094	\$262,152.00	34.7162	32	34.7112	2	AC	3030 - 04
AR	72.401	77.957	4543138	5.556	\$395,253.00	38.324	38	38.324	2	AC	3030 - 04
AR	77.957	84.926	4542260	6.969	\$958,529.00	42.2791	38	42.2791	2	AC	3030 - 04
AR	84.926	85.589	4542155	0.663	\$0.00	88.2157	63	88.2157	4	AC	3030 - 04
AR	85.589	87.181	4543111	1.572	\$336,526.00	63.9816	32	63.9816	4	AC	3030 - 04
AR	87.181	94.404	4543068	7.243	\$4,869,500.00	32.4954	32	32.4954	2	AC	3030 - 04
AR	94.404	99.483	4542164	5.079	\$1,348,826.00	35.7895	34	35.7895	2	AC	3030 - 04
AR	99.483	100.930	4543620	1.447	\$694,479.00	48.3853	35	48.3853	3	AC	3030 - 04
AR	100.930	105.942	4542499	5.042	\$1,348,495.00	38.6343	35	38.6343	4	AC	3030 - 04
AR	105.942	111.624	4542267	5.682	\$1,876,753.00	32.6624	32	32.6624	2	AC	3030 - 04
AR	111.624	117.887	4542308	6.227	\$488,471.00	34.6549	32	34.6549	2	AC	3030 - 04
AR	117.887	118.332	1642334	0.445	\$88,282.00	66.2614	66	66.2614	1	LC	3030 - 04
VR	111.645	113.981	4245300	2.336	\$168,451.00	34.6248	35	34.6248	3	YC	3030 - 04
VR	100.943	111.624	4245386	2.683	\$1,348,422.00	38.6324	35	38.6324	3	YC	3030 - 04
VR	100.930	105.943	4245388	2.043	\$2,148,452.00	38.6343	38	38.6343	4	YC	3030 - 04
VR	88.483	100.930	4245388	1.447	\$694,479.00	48.3853	38	48.3853	3	YC	3030 - 04
VR	88.484	88.483	4245388	2.018	\$1,148,228.00	32.6612	31	32.6612	3	YC	3030 - 04

Transportation Asset Management Analytics

Analysis Methodology

Ranking Methods

- Worst First
- Custom Prioritization
- Incremental Benefit

Optimization Methods

- Analyze Multiple Constraints
- Single and Combined Objectives
- Section Strategy Analysis

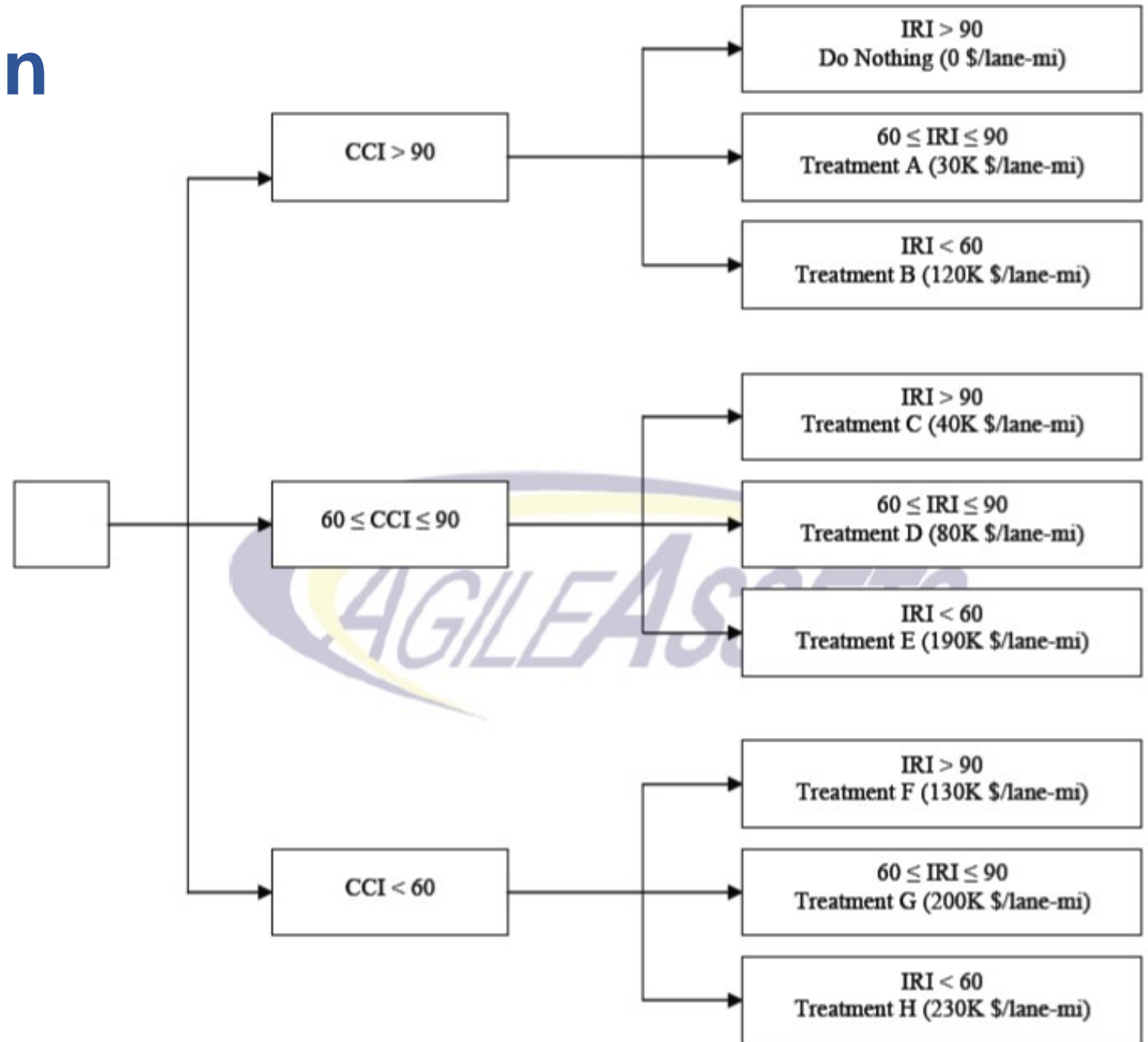


Multi-Constraint Optimization: Pavement Example

- Create an optimal work program using objectives and multiple constraints
- Analysis indicates a series of treatments
 - applied to individual assets over time
 - to minimize the treatment cost
 - or maximize the condition-based benefit subject to constraints



Treatment Selection Decision Tree (Pavement Example)



- Acronyms:

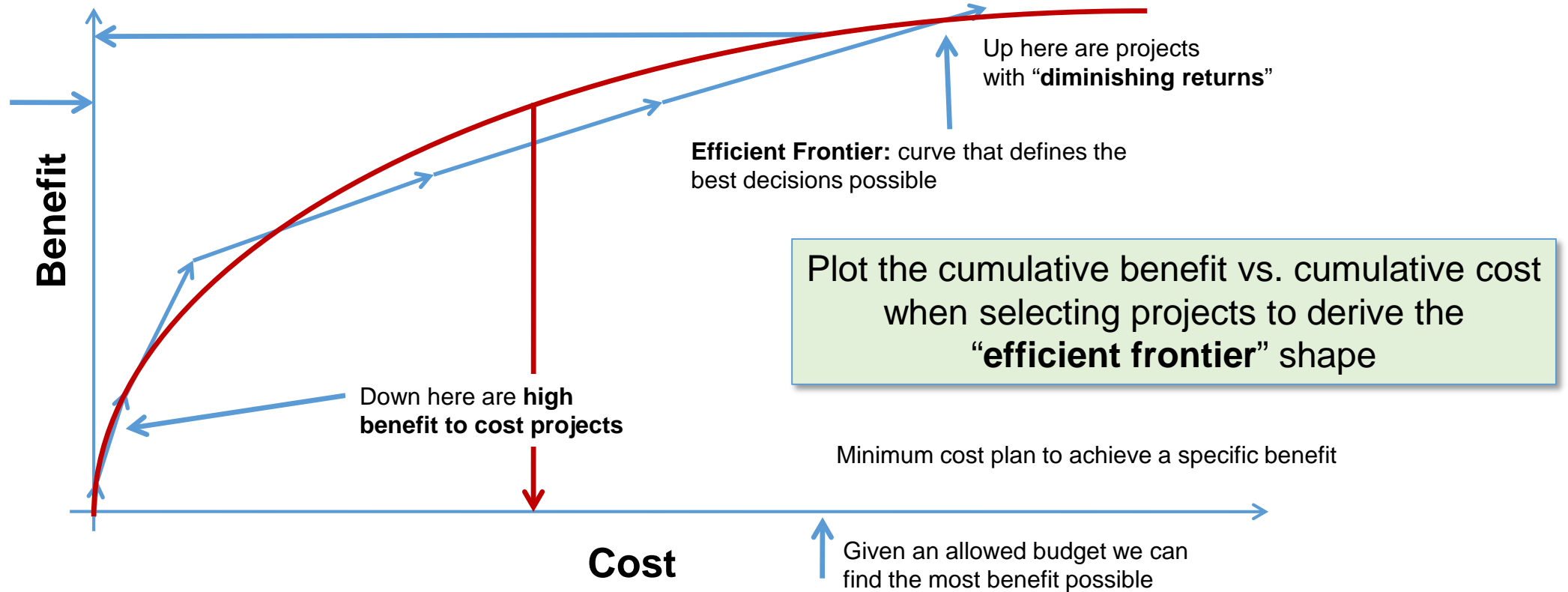
- CCI: Critical Condition Index
- IRI: International Roughness Indicator Index

The *Efficient Frontier* for TAM

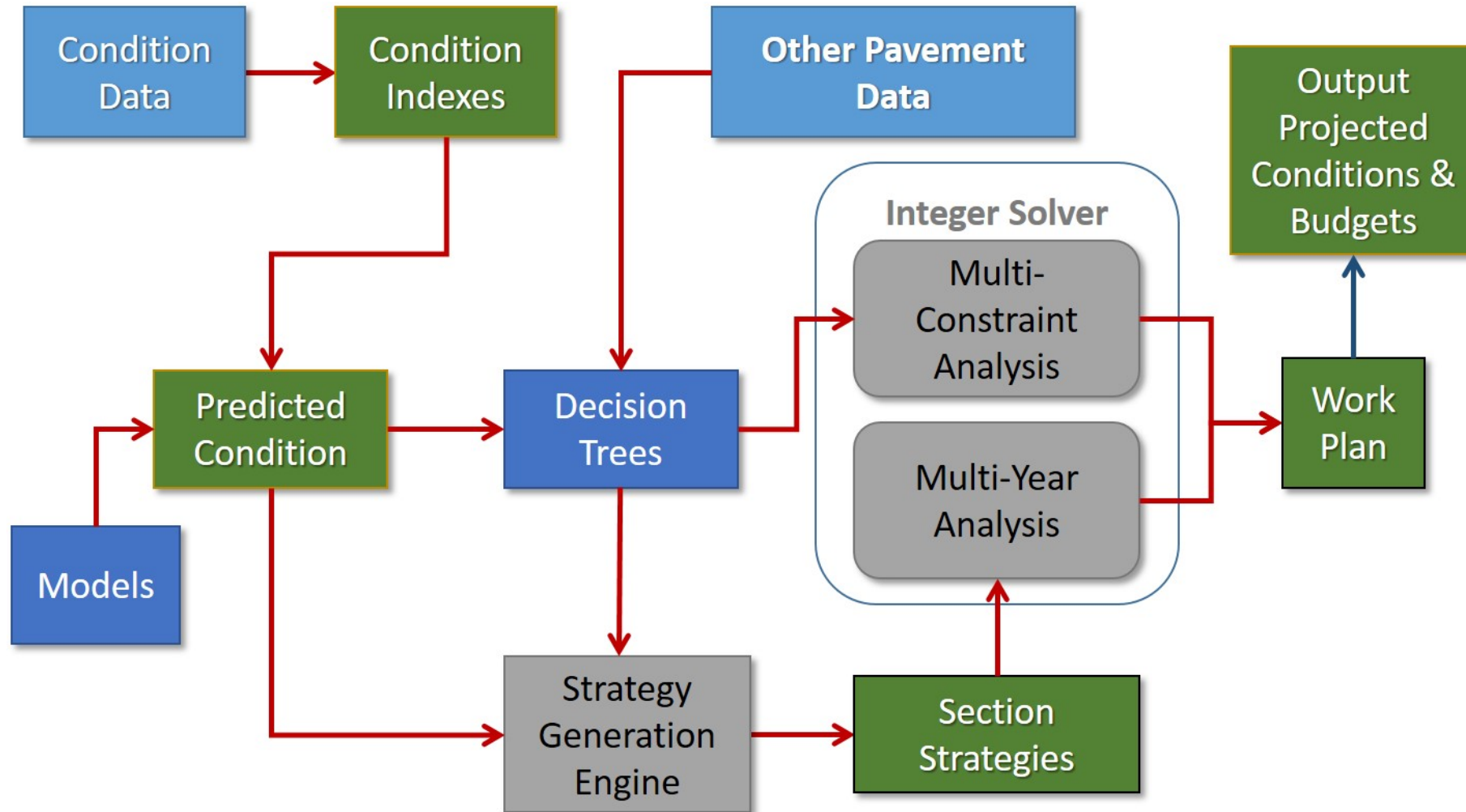
- Prioritize and optimize allocation of maintenance funds
- Models data to determine the maintenance *level of service* (LOS) that can be achieved
 - *within* a given budget or
 - the budget *required* to achieve a desired LOS



The Efficient Frontier



Optimization Analysis – Logic

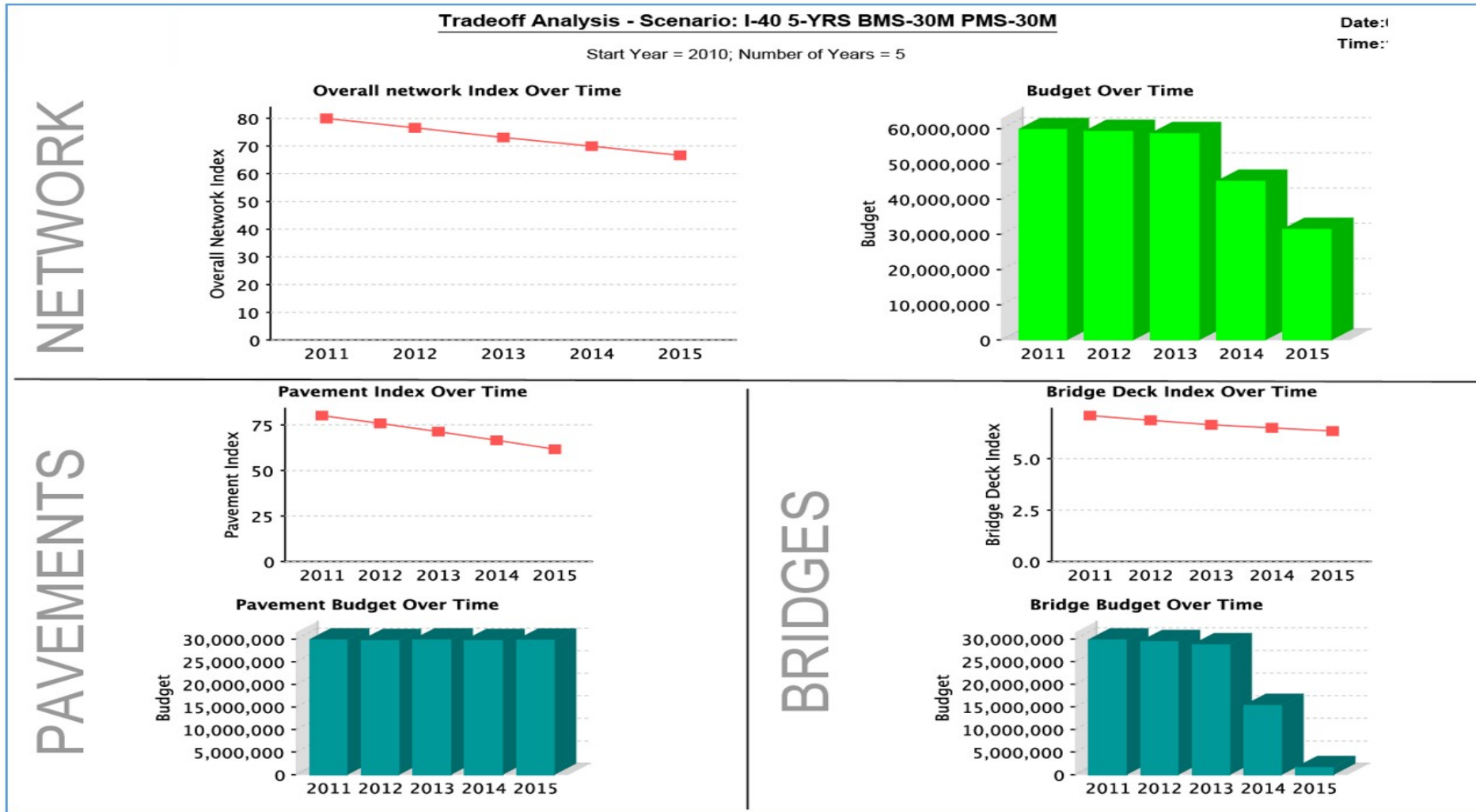


Multi-Constraint Analysis Result (Example)

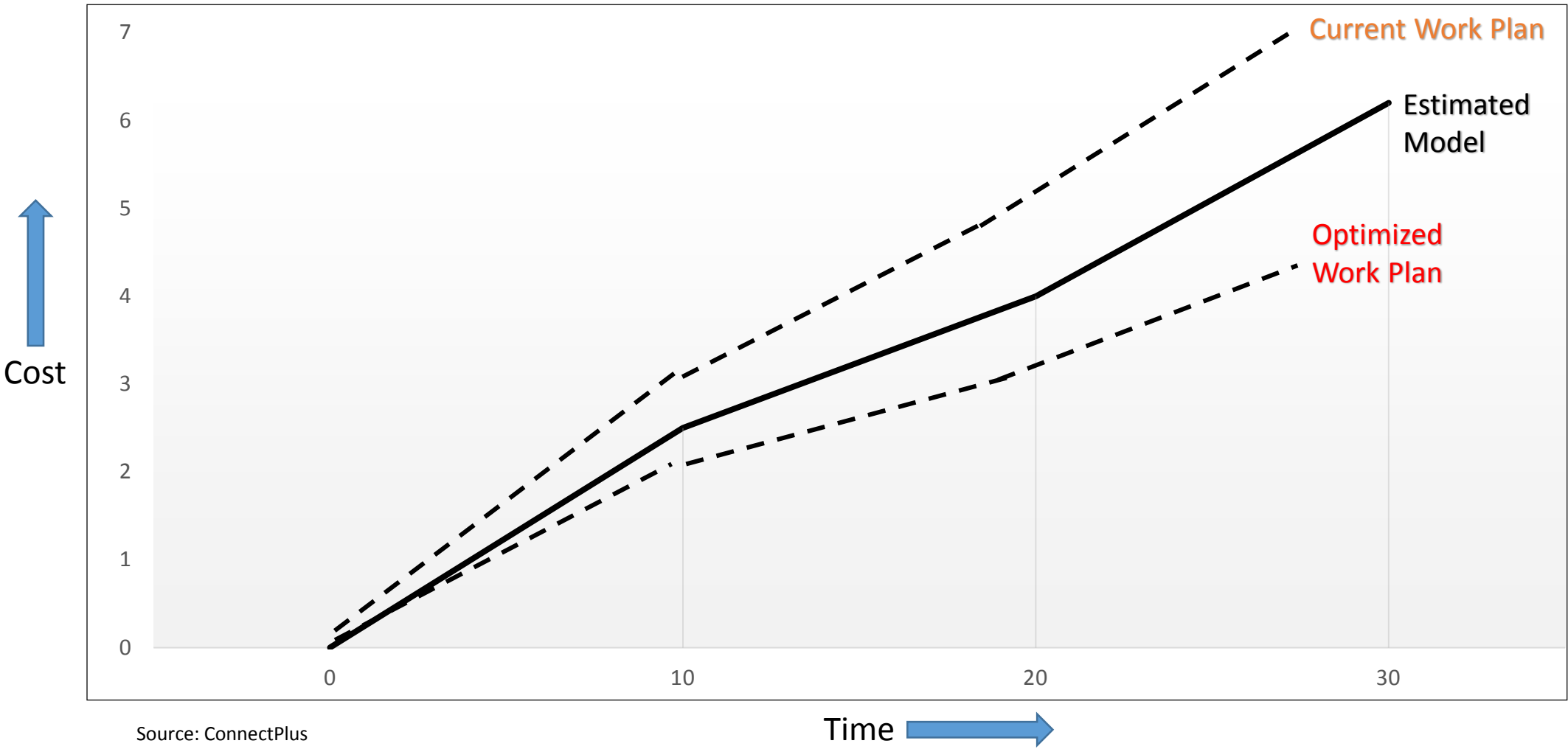
The **optimal solution** found by Multi-Constraint Analysis:

Year	Project on each section						Budget (\$)	Spending (\$)	Weighted average Performance index - PI
	1	2	3	4	5	6			
1		CM					50,000	23,750	49.3
2				CM			100,000	82,728	50.0
3					RM		100,000	93,645	50.8
4		PM					150,000	3,282	47.1
5							150,000	0	43.1
5-Year Average:									48.1

Trade-off Analysis: Comparing Multiple Bridge & Pavement Scenarios (Example)

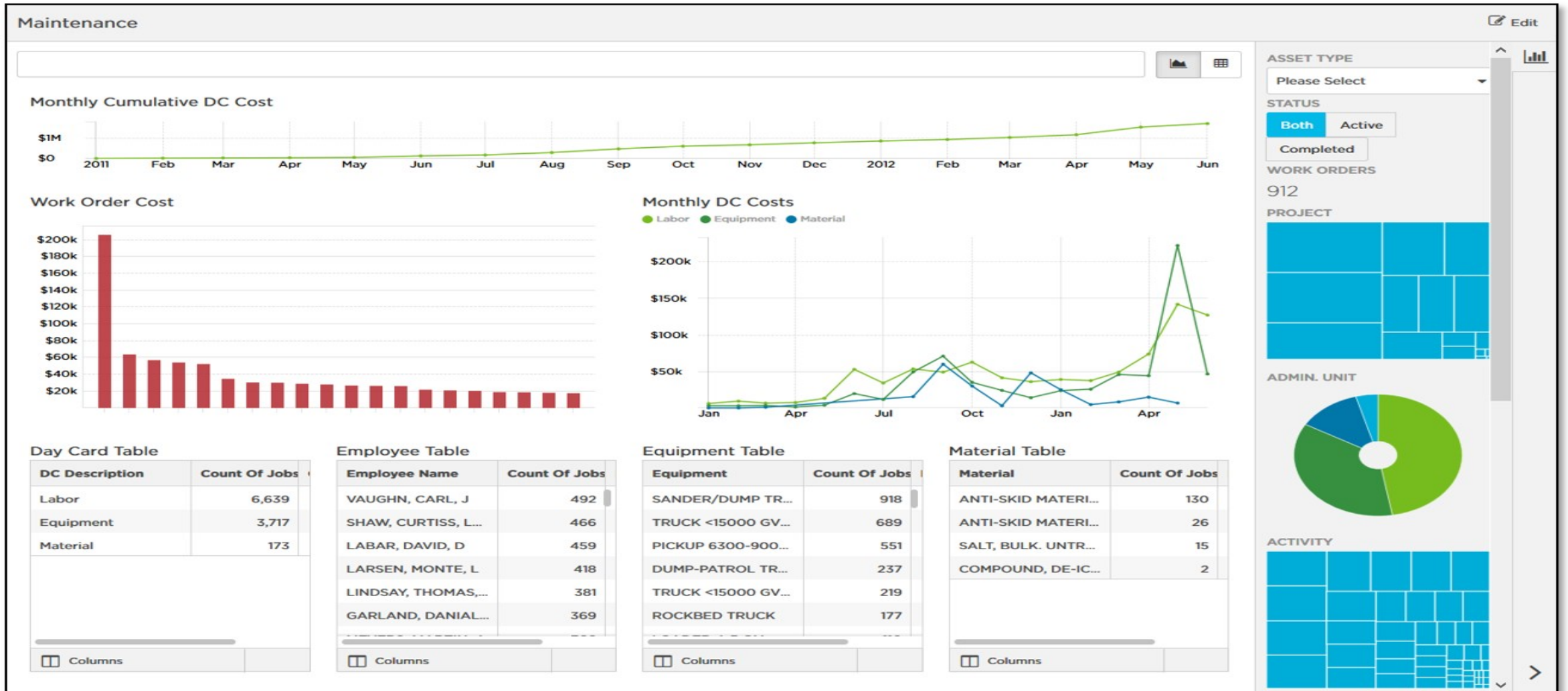


Visualize Optimization With Decision Support

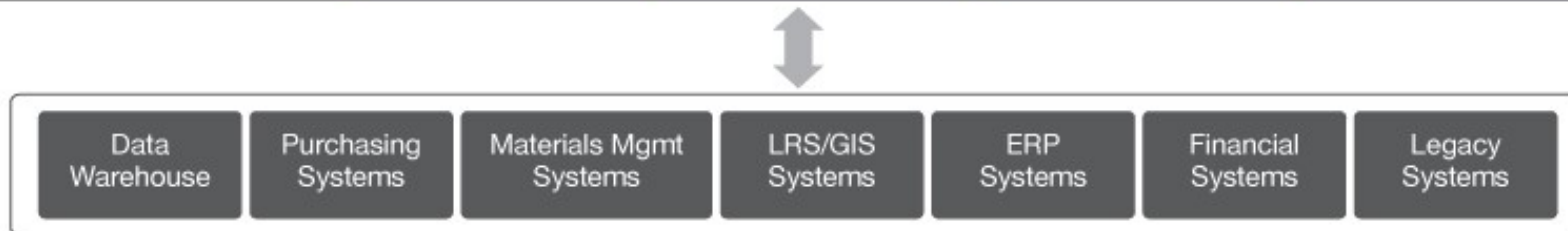
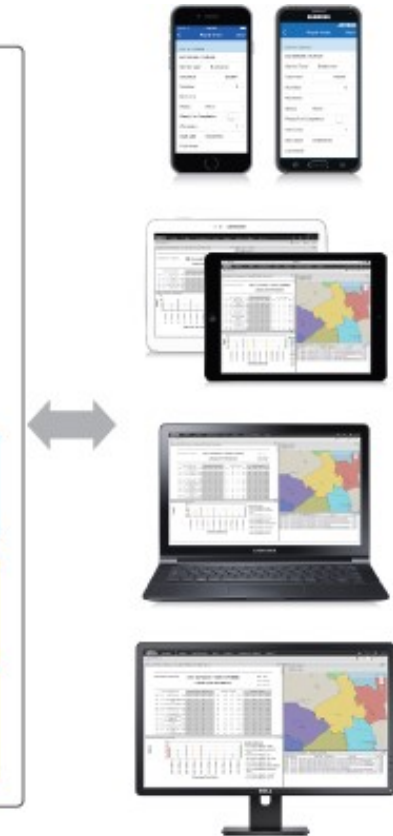


Source: ConnectPlus

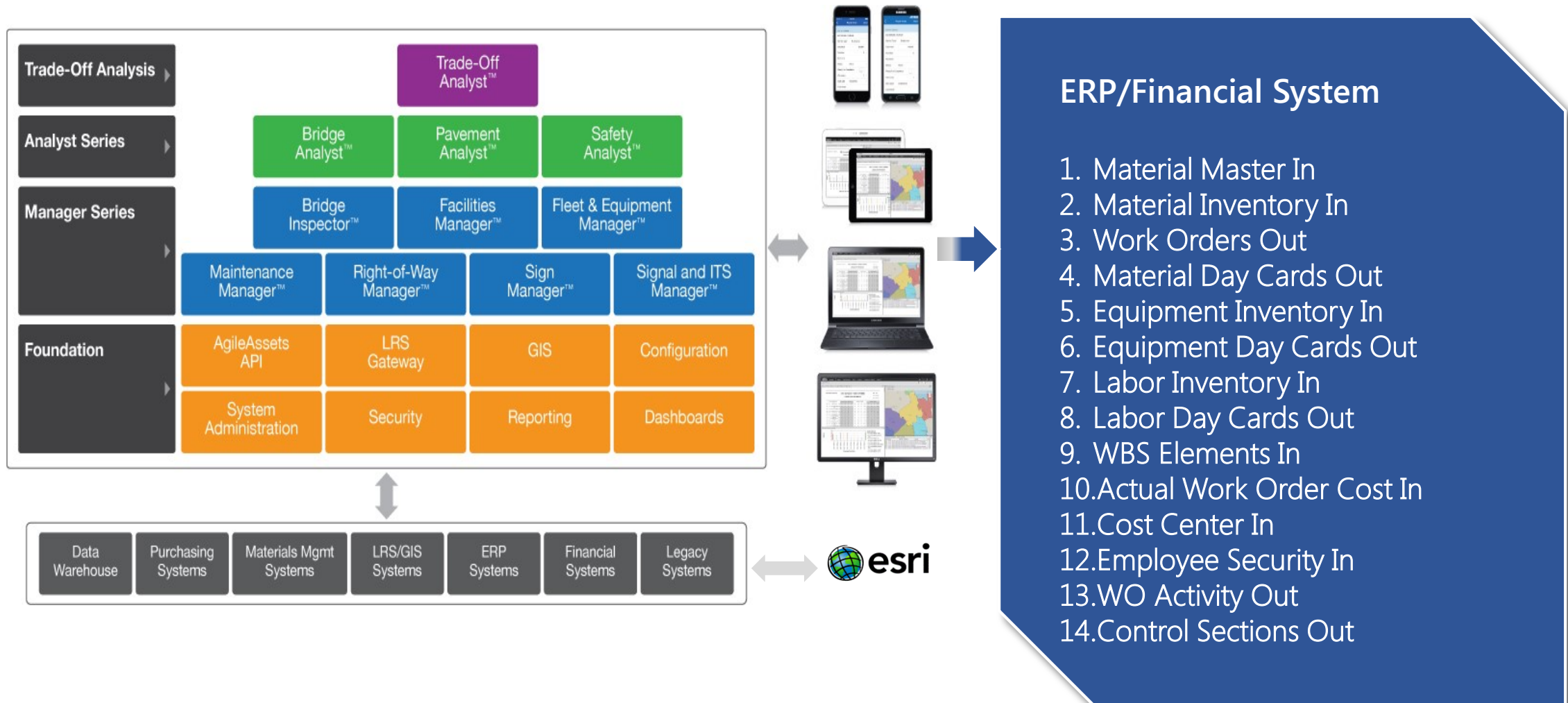
Asset Management Dashboards Business Intelligence for Toll Infrastructure



Integrated Transportation Asset Management (TAM) Application Suite (Example)



TAM Systems - Integration Not Isolation



Save the Assets, Save the World

- Balance your infrastructure maintenance investment across all assets
- Acquiring TAM analytical tools to optimize needs with cost investments
- Build TAM dashboards and KPIs to monitor infrastructure asset performance
- **Drive greater toll profitability and sustainability through technology**



Thanks for listening



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