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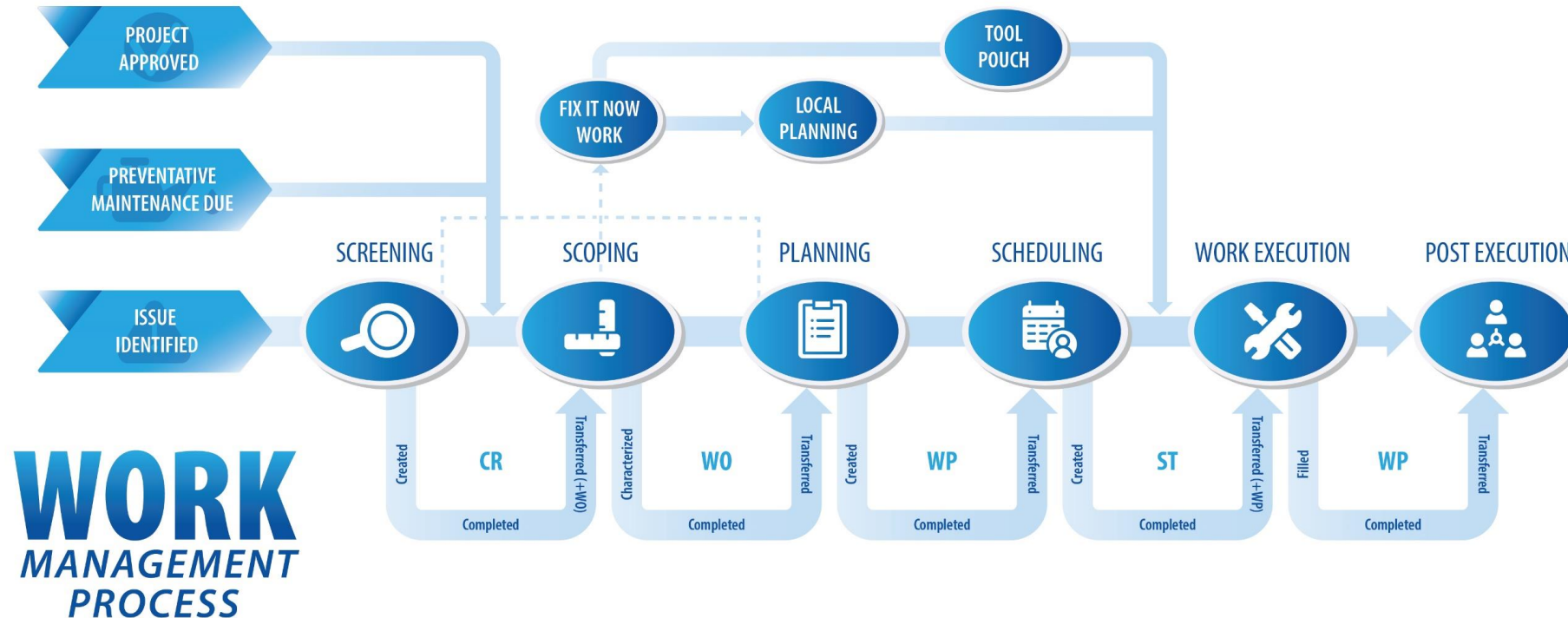
Scalable Methods to Automate Manual Work Management Decisions using Artificial Intelligence

Presented to the DOE LWRS Plant Modernization Pathway Stakeholder Engagement Meeting

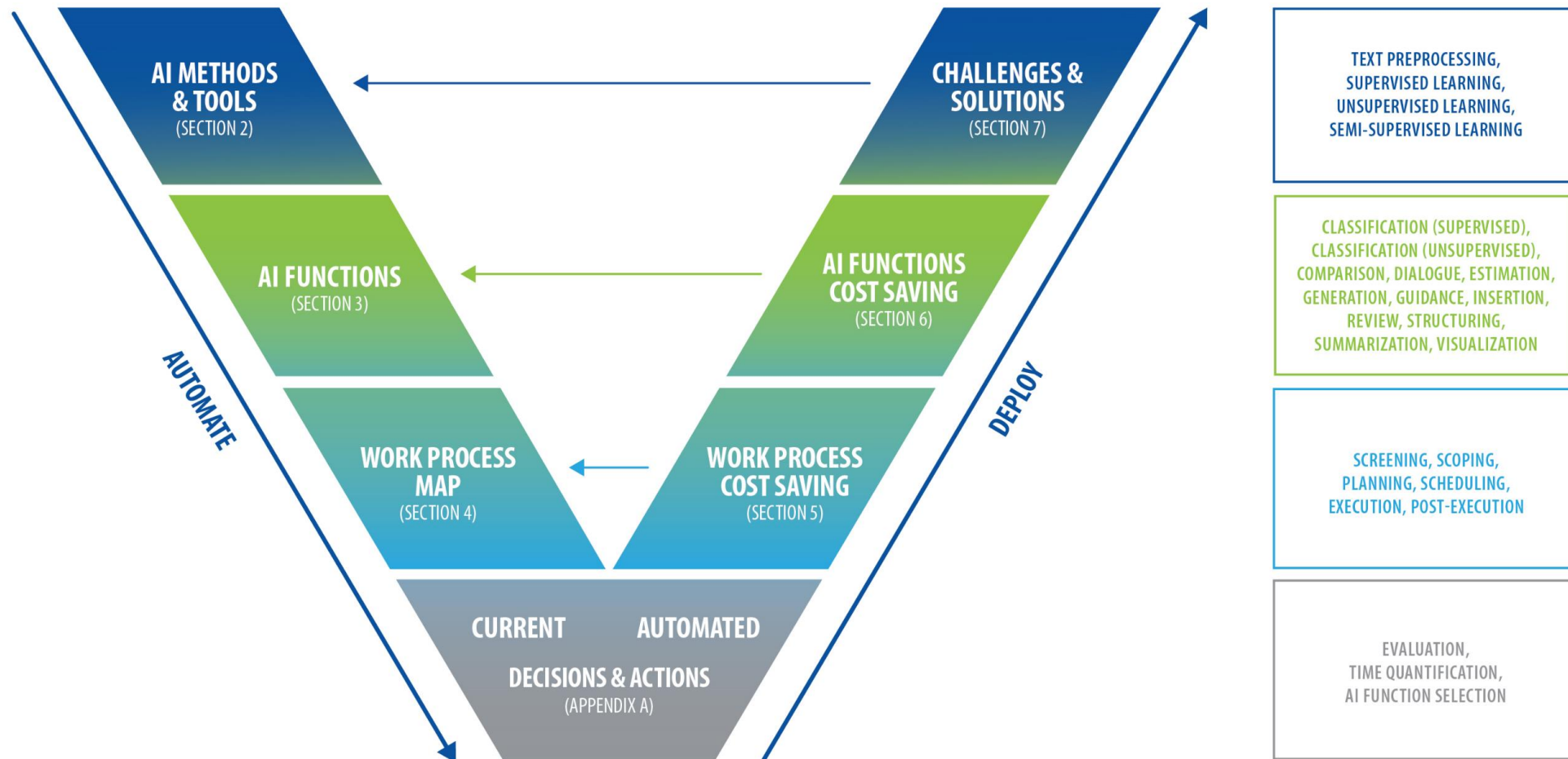


Motivation

- The work management process is both time-consuming and costly
- Due to the importance and complexity of the work management process and the involvement of multiple organizations, routine tasks can incur significant expenses, often reaching thousands of dollars per work package due to extensive staff involvement across various phases.



Research Overview



Scalable AI Methods and Tools Used For Text Analysis

Text Preparation

- Rules-Based Processing
- Tokenization
- Vectorization
- Embedding

Supervised Learning

- Regression

Unsupervised Learning

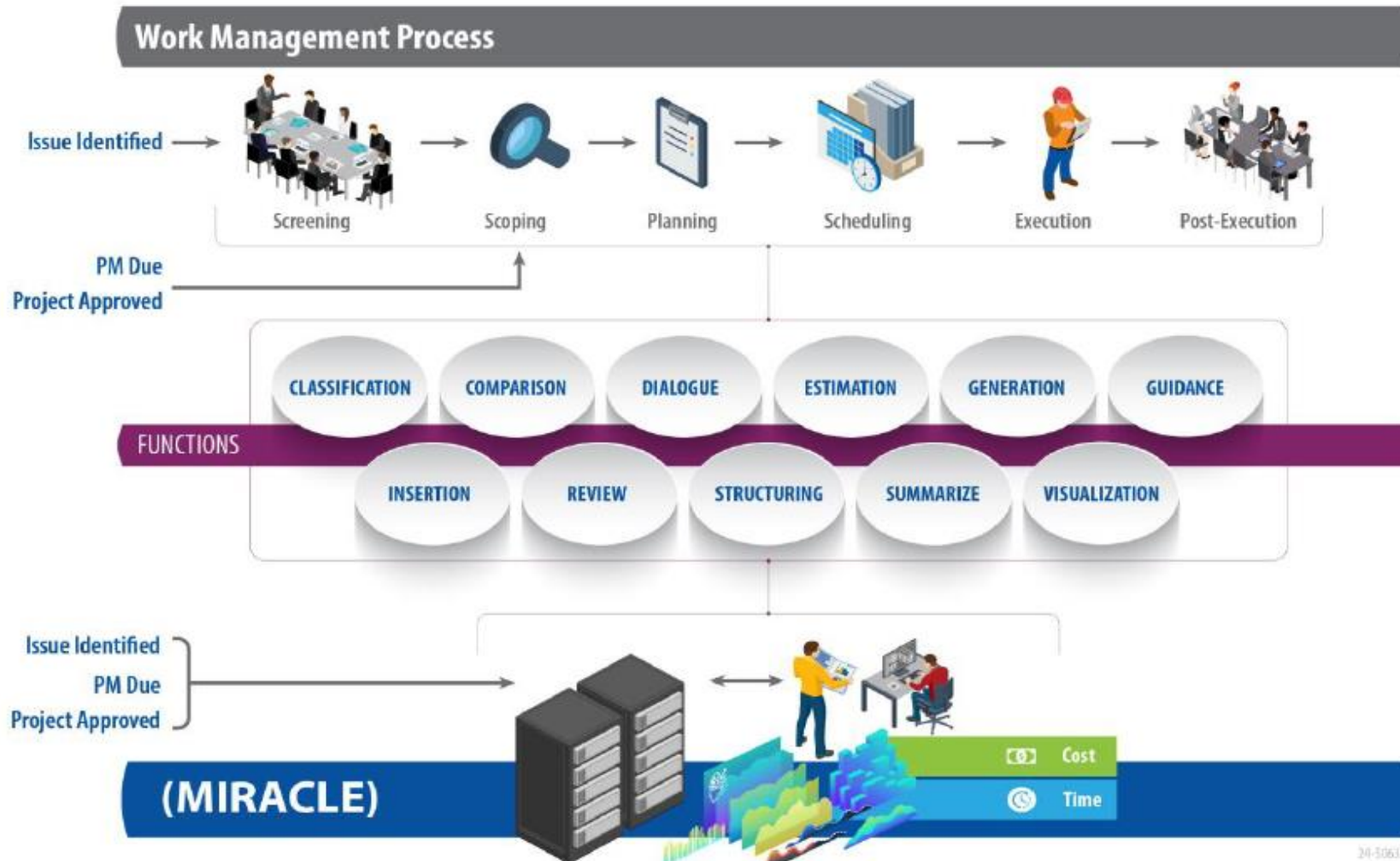
- Clustering
- Dimensionality Reduction
- Generative AI
- Similarity Analysis
- Topic Modeling

Semi-supervised Learning

Generative AI Methods Used For Text Analysis

Model	Autoregressive Models	Encoders-Decoders	Dialogue Models	Generative Adversarial Networks (GANs)	Retrieval-Augmented Generation (RAG)
Objective	Reconstruct text based on its knowledge	Reconstruct text in targeted manner based on training	Interact with users in a coherent manner	Generate new data out of examples of historical data	Searches through large set of documents to create answers from the documents
How it Works	Predict the next word using a regression	Predict the text using the whole representation of the input	Trained on generic questions and answers	Iterate over fake data until it looks like (but is not) the data	Finds text related to the query and formats it in an answer to the query
Strength	Mimic human text generation	Clean up and augment data	Improve response coherence	Can create novel data	Can mine large sets of existing data

Work Management Process



Work Mapping: Current Decision-Making Process

Decision	Effort Description	Discipline	Time in Minutes	Frequency Per CR
Process	Check if the condition was previously identified. e.g., there is a tag on the equipment or is in the condition reporting system	Any	3	150%
If yes	Add comments to the existing condition if needed. (End of Process)	Any	2	50%
If no	Write a CR.	Any	5	100%
Total (minutes FTE per CR)			10.5	

Typical Annual Work Management Throughput (per Unit)

Phase	Metric	Scale to previous metric	Assumed number per unit per year
Screening	CR	Not applicable (NA)	6,000
Scoping	WO	One corrective WO per five CRs	1,100
		Project WOs	400*
		PM WOs	6,000
		Total WOs	7,500
Planning	WP	Four WPs per three WOs	10,000
Scheduling	ST	Two STs per WP	20,000
Execution	WP	One WP to two STs	10,000
Post-Execution	WP		10,000

Work Mapping: Automated Decisions and Conditional Actions

Decision	AI Description			
	Training/Reference Input	Use Input	Functions	Output
Process	Historical CRs	Identified and reported condition text	Comparison	Yes/No (and previous CR)
If yes	Previous CR	Identified and reported condition text	Generation	Modified CR text
If no	Historical CRs	Identified and reported condition text	Guidance	New CR text
	Historical CRs	Identified and reported condition text	Insertion	New CR text

Current Costs vs Potential Cost Savings – Screening Example

Task	Current Cost (in \$K per unit per year)	Maximum AI Cost Reduction (%)
Equipment Relevance	10	100
Criticality	30	100
Rework	45	100
Severity	62	98
Actions Needed	40	100
....		
Maintenance Work Order Creation	13	71
Total/Average	1,526	57.6

Potential Cost Savings Using AI to Automate Work Management Process

Phase	Current Cost Per Unit Per Year	AI Cost Saving Per Unit Per Year	Ratio of Saving
Screening	\$1.53M	\$0.88M	57.6%
Scoping	\$2.50M	\$2.13M	85.2%
Planning	\$7.79M	\$7.72M	99.1%
Scheduling	\$1.96M	\$1.32M	67.2%
Execution	\$4.45M	\$1.78M	40.1%
Post-execution	\$0.16M	\$0.14M	84.4%

Example Challenges

- Sparse Categories (e.g. SCAQ)
- Consistency of Categories over time or across utilities
- Prompt Sensitivity
- Missing Context or Mixed Context
- Many others

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Light Water Reactor Sustainability Program

Scalable Methods to Automate Manual Work Management Activities Using Artificial Intelligence

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Other Benefits of Using AI to Automate Work Management Process

Improved Equipment
Reliability

Improved Maintenance
Strategy Implementation

Improved Scope Stability

Proactive Obsolescence
Identification

Reduced Inventory
Growth

Reduced Expediting
Costs

Better Work Package
Quality

Better Execution Week
Critique



Sustaining National Nuclear Assets

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