MacGyvering Cost Estimating:

Equipping Estimators with a Swiss Army Knife for the AI Era

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Introduction

In the current landscape of cost estimation, professionals often find themselves navigating a fragmented ecosystem of tools—spreadsheets for calculations, search engines for research, databases for historical data, and standalone artificial intelligence applications for analytics. This piecemeal approach, while resourceful, is inefficient and prone to error, much like the improvisational problem-solving associated with MacGyver. The time has come to transition from a patchwork methodology to a comprehensive, intelligent solution—a true Swiss Army knife for the modern estimator.

This paper explores the transformative potential of an AI-enhanced cost estimating tool that consolidates multiple capabilities into a single, unified platform. By integrating machine learning, large language models, and Retrieval-Augmented Generation (RAG), this tool enables cost estimators to execute complex tasks with greater precision, speed, and adaptability. The result is not merely a technological upgrade, but a paradigm shift in how cost estimation is performed.

While the primary focus is on streamlining the cost proposal process for contractors responding to high-value Requests for Proposals (RFPs)—especially sole-source bids—this approach holds equal promise for government estimation workflows. As this paper will demonstrate, equipping estimators with this AI-powered Swiss Army knife enhances efficiency, improves accuracy, and positions organizations for long-term competitive advantage in the AI era.

Prior Relevant AI and Machine Learning (ML) Research

In a search through the past International Cost Estimating and Analysis Association (ICEAA) Workshop Proceedings from 2007 through 2024, 56 Titles appeared, using either “Artificial Intelligence” or “Machine Learning” as the search criteria. Of these 56 Titles, only six presentations, without an accompanying paper, addressed process improvements beyond cost estimating by using AI or ML tools. The closest previous presentation by Steven Glogoza showed how automation using AI and ML tools may change cost estimator training and development in the future. This paper is unique in exploring how an AI-enhanced cost estimating tool can lead to process improvements.

List of six relevant presentations:

1. “Don't be Scared, Machine Learning is Easy,” Mary Johnson, Dakota Shafer, 2019. A presentation documenting a case study exploring the data cleaning and modeling process for a cost estimate done on DoD installations.
2. “Estimator development and process automation,” Steven Glogoza, 2021. A presentation on how automating estimating activities will affect training and development of cost estimators.
3. “Integrating Data Science & Cost Analysis,” Sarah Green, 2022. A presentation on innovative ways that AFCAA utilized a cloud based platform and various data science tools to transform their processes.
4. “Automation and Process Improvement in Cost Estimating,” Anil Divvela, 2024. A presentation that demonstrates simple Python use cases that automate time consuming redundant tasks that every Cost Estimator hates.

5. “AI and Machine Learning/Data Science Tools for Cost Analysis,” Daniel Harper, 2024. A presentation overview of modern usages of data science, to include Machine Learning, AI and data visualization, use
6. “Industry Leaders' Insights: Enhance Efficiency and Simplify Your Work Using AI,” Karen Richey Mislick, 2024. A presentation on the practical experiences and insights gleaned from industry frontrunners effectively utilizing data analytics and AI technologies.

Focus on AI-Enhanced Cost Tools

The emergence of AI-enhanced cost tools marks a pivotal shift in the evolution of proposal cost estimating. Traditional methods, reliant on a constellation of isolated software applications and manual inputs, often resemble an improvised toolkit—functional, yet inherently inefficient. In contrast, an integrated AI-driven platform offers the equivalent of a precision-engineered Swiss Army knife: a singular, cohesive solution capable of addressing a wide range of estimating challenges with accuracy, speed, and adaptability.

Unlike conventional tools such as Excel—which, while flexible, lack scalability and structured knowledge management—AI-enhanced tools combine automation, intelligent data processing, and natural language interaction within a unified interface. This convergence not only accelerates the estimation process but also improves consistency, traceability, and collaboration across proposal teams. Such a platform transforms estimation from a reactive process into a proactive strategy, enabling more refined, data-informed decision-making.

A defining characteristic of these AI-enhanced tools is their ability to populate and interact directly with cost estimating data structures. This capability eliminates the need for redundant data entry, allowing AI-generated results to be seamlessly integrated into estimating outputs. The platform becomes not just a calculation engine, but a dynamic workspace that supports the full lifecycle of cost development—from early estimates and trade analysis to compliance documentation and final pricing.

Underpinning these tools are advanced technologies such as Large Language Models (LLMs), machine learning algorithms, and Retrieval-Augmented Generation (RAG). These components collectively empower the system to interpret complex requirements, analyze historical and market data, and generate predictive insights with contextual relevance. By doing so, they elevate the cost estimating function to a strategic enabler—allowing organizations to respond rapidly to RFPs, reduce proposal development costs, and maintain competitive positioning.

In essence, the AI-enhanced cost tool embodies the multi-functionality and precision of a Swiss Army knife, equipping estimators with a consolidated, intelligent platform that adapts to the evolving demands of modern acquisition environments.

Key AI Concepts

AI concepts discussed in this paper include LLMs, ML tools, and the RAG concept. These advanced technologies underpin the functionality of AI-enhanced cost tools, enabling them to perform complex tasks with speed and precision.

LLMs, for instance, are instrumental in processing large volumes of text data, allowing the tool to summarize financial documents, draft proposal sections, and provide insightful analyses. By incorporating LLMs, the tool can understand and generate human-like text, making it easier to create coherent and persuasive narratives for proposals.

ML tools further enhance the capabilities of AI-enhanced cost tools by analyzing data to identify patterns, trends, and anomalies. These tools can generate predictive insights, optimize costs, and assess risks, providing a robust framework for decision-making. Machine learning algorithms continuously learn from new data, ensuring that the tool remains adaptive and accurate over time.

However, one of the challenges in using ML models is the requirement for training data. Effective ML models rely heavily on a large, quality dataset to learn and adapt. This need for extensive data can pose a significant hurdle, particularly in industries where data may be scarce or highly confidential. The construction industry, and some high-volume manufacturers should have data available to use ML tools in cost estimating. A further discussion of ML training data is provided in the Challenges section at the end of this paper.

The RAG process is a cutting-edge approach that combines the strengths of information retrieval and generative models to produce accurate and context-rich outputs. In the context of AI-enhanced cost tools, RAG operates by first retrieving relevant information from vast data sets, both internal and external to a company's firewall, including databases, documents, and other sources. This retrieved data provides a solid foundation of factual content that the system can build upon.

Once the relevant information is gathered, the generative model, powered by advanced LLMs, takes over. It processes the retrieved data to generate coherent and contextually appropriate responses. This dual mechanism ensures that the generated outputs are not only based on up-to-date and accurate information but are also articulated in a manner that is comprehensible and relevant to the user's needs.

The retrieval component is crucial as it ensures that the AI tool has access to a wide array of data points, making the information provided comprehensive and well-rounded. On the other hand, the generative aspect allows the AI to construct narratives, explanations, and summaries that are not just accurate but also engaging and easy to understand.

This integrated approach is particularly beneficial in cost estimation and proposal writing, where precision and context are paramount. By leveraging the RAG process, AI-enhanced tools can produce high-quality cost estimates, draft proposal sections, and provide detailed analyses that are both data-driven and contextually grounded.

Tools can either improve or impede processes

Tools have always played a significant role in shaping labor processes, and their introduction into workplaces can greatly enhance productivity and efficiency. By automating repetitive tasks, increasing precision, and reducing the need for manual effort, tools allow workers to focus on more complex and

creative aspects of their jobs. For example, in manufacturing, advanced machinery has streamlined production, reducing the time and effort needed to produce goods. In digital industries, software tools enhance workers' ability to process data, communicate, and collaborate, often leading to innovative outcomes and higher levels of efficiency. Overall, tools can reduce physical strain and make work more accessible and manageable, opening up opportunities for greater output and professional growth.

However, tools can also hinder labor processes, particularly when they displace workers or create dependency. Automation, while boosting productivity, can lead to job losses as machines replace human labor in routine tasks. In many cases, workers may find their roles de-skilled, becoming reliant on tools that do most of the work, thereby reducing their sense of ownership and mastery over their tasks. Moreover, constant changes in tools and technologies can lead to disruption, requiring workers to continuously adapt and learn new systems, which can be time-consuming and stressful. Poorly designed tools or overly complex systems can also introduce inefficiencies, as employees spend more time troubleshooting issues or navigating confusing interfaces. In these ways, tools have the potential to complicate the labor process and contribute to job insecurity.

Despite these advancements, it is important to recognize that implementing an AI-enhanced cost tool on top of a poorly designed process may not yield the desired improvements. In fact, such a tool can amplify existing inefficiencies if the underlying processes are flawed. For instance, if the data inputs are inaccurate or inconsistent, the AI tool's outputs will reflect these inaccuracies, leading to misguided estimations and decisions.

Therefore, to truly harness the benefits of AI-enhanced tools, organizations may need to undergo a process reengineering. This involves critically evaluating and redesigning their workflows to align with the capabilities of the AI tool. Streamlining data collection methods, ensuring data quality, and establishing clear protocols for data integration are essential steps in this transformation. By aligning the AI tool with optimized processes, organizations can unlock its full potential, leading to more accurate cost estimations, improved efficiency, and better decision-making.

Moreover, adapting to new processes can be challenging and may require significant changes in organizational culture and employee roles. Training and change management initiatives are crucial to ensure that employees are equipped to use the new tool effectively and to foster a culture of continuous improvement. Ultimately, while an AI-enhanced cost tool offers substantial benefits, its success is heavily dependent on the quality and adaptability of the existing processes and the organization's willingness to embrace change.

Characteristics of an AI-enhanced cost tool

An AI-enhanced cost tool should mimic a company's estimating and pricing toolset while utilizing LLM and ML capabilities. This integration can significantly improve the efficiency and accuracy of cost estimations by automating data analysis, identifying trends, and generating predictive insights. By leveraging LLMs, the tool can facilitate natural language processing tasks such as summarizing RFP and Statements of Work documents and drafting proposal sections, thereby streamlining the workflow. ML

algorithms can assist in detecting patterns and anomalies, providing a robust framework for risk assessment and cost optimization.

What truly differentiates an AI-enhanced cost tool from the current collection of tools performing similar functions is the ability to populate an estimating data structure that becomes the baseline for the cost proposal output tables. Without an AI-enhanced cost tool, any AI generated results must be manually entered into a cost tool for use in estimating and reporting.

The ability to view and write results back into the cost tool ensures a seamless loop of feedback and continuous improvement. This bidirectional interaction allows for dynamic updates and refinements, ensuring that the data remains current and relevant. Furthermore, incorporating AI capabilities can enhance the transparency and traceability of cost estimations, offering detailed justifications and rationales for the figures generated. These features collectively contribute to a more informed and strategic approach to cost management, empowering Subject Matter Experts (SMEs) and decision-makers with reliable, data-driven insights.

Data security using AI tools

To effectively leverage AI tools like LLMs, ML, and RAG while safeguarding proprietary data, companies must implement robust security measures. This includes role-based access controls (RBAC), data encryption, and anonymization techniques to prevent unauthorized exposure. Deploying AI models in secure environments, whether on-premises or within a private cloud, minimizes risk, while strict access policies on vector databases and knowledge bases protect sensitive information. Vendor risk management, compliance with data privacy laws (e.g., GDPR, HIPAA, CCPA), and continuous monitoring for anomalies further ensure AI usage remains secure. Additionally, organizations should train employees on AI security best practices and establish incident response protocols to address potential breaches.

To support AI operations efficiently, companies need an enhanced Information Technology infrastructure capable of handling high computational demands. This includes Graphics Processing Unit (GPUs), Tensor Processing Unit (TPUs), or cloud-based AI services for training and inference, along with high-speed data storage and low-latency networks to manage vast datasets. Scalability and automation are crucial, with Machine Learning Operations (MLOps) pipelines, containerized deployments (Docker, Kubernetes), and hybrid cloud solutions ensuring smooth AI integration. Advanced cybersecurity frameworks, such as zero-trust architectures and Application Programming Interface (API) management systems, further protect AI models and prevent unauthorized access. Additionally, energy-efficient AI infrastructure and sustainable computing strategies help optimize operational costs while maintaining AI performance at scale.

Reengineering the Pricing Function

The adoption of an AI-enhanced cost tool offers organizations an opportunity to fundamentally rethink the structure and operation of their pricing functions. Much like replacing a drawer full of single-purpose

instruments with a well-designed Swiss Army knife, this tool consolidates and automates key pricing activities—enabling faster, more consistent, and more strategic execution. With its ability to perform real-time cost and pricing computations, the tool reduces the need for a separate pricing organization and empowers cross-functional teams to manage estimating, compliance, and cost volume preparation more collaboratively and efficiently.

Despite this shift, the core knowledge competencies that pricers possess remain vital and cannot be discarded. Instead, these competencies can be effectively redistributed to existing contracts and business organizations that perform routine project control, cost and resource management, and rate analysis. By integrating pricing expertise within these groups, companies can leverage their existing strengths and ensure comprehensive pricing process continuity.

The key pricing competencies that are redistributed include:

- Knowledge of which direct and indirect rates to apply
- Ensuring proper pricing algorithms are applied to estimated hours and dollars
- Compliance with RFP and governance rules

The first two competency bullets above can be moved in a business organization that already possesses competencies in rate management, estimating, and project control. With the business organization absorbing pricing expertise, they can enhance the knowledge base of their existing business staff, ensure seamless integration of cost estimation processes, and increase the pool of staff available to support proposals.

Similarly, the contracts organization, with its established proficiency in compliance, is well-suited to oversee adherence to RFP and regulatory requirements.

This strategic redistribution of pricing competencies supports a more agile and integrated approach to cost management, empowering organizations to optimize their processes while maintaining compliance and accuracy.

Another benefit of redistributing the pricing function to the business and contracts organization is to prevent “pricer burnout,” a common issue in many companies. This burnout often arises from pricers having to wait until the final moments of the proposal process to receive multiple inputs from engineering and supply chain functions, as well as dealing with last-minute changes from senior management. By training more business and contracts personnel in pricing competencies, the burden of last-minute proposal finalization can be dispersed across a broader pool of staff. This not only reduces the stress on individual pricers but also ensures a more collaborative and efficient process, ultimately leading to more accurate and timely proposal submissions.

Example of Reengineered Pricing Function

For a medium-sized contractor completing 15 competitive and 30 sole-source proposals annually, managing workload fluctuations and ensuring efficiency across business, contracts, and pricing organizations is crucial. This example outlines a strategy to redistribute roles and responsibilities,

ensuring a more balanced workload and leveraging AI-enhanced tools to optimize processes. The current organizational structure has:

- Business Organization: 12 employees
- Contracts Organization: 9 employees
- Pricing Organization: 5 employees (2 estimators, 3 cost volume preparation and compliance specialists).

The typical workload for these organizations is:

- Business Organization: Steady 40 hours per week
- Contracts Organization: Steady 40 hours per week
- Pricing Organization: Average 40 hours per week with significant variations due to RFP deadlines

Despite these well-defined roles, several challenges arise:

- Pricing organization faced with unpredictable workloads, leading to pricer burnout
- Uneven distribution of responsibilities between organizations
- Potential inefficiencies and bottlenecks in proposal preparation

To tackle these challenges, the business organization would absorb the two estimators, and the contracts organization would absorb the three specialists in cost volume preparation and compliance. Overall, the total number of employees has not initially changed, just the distribution across organizations. Overtime, efficiencies in processes, optimized using an AI-enhanced cost tool will allow a company to prepare more RFP responses without growing staff.

Another benefit of this redistribution would be to ensure that all employees work closer to a standard 40-hour week, preventing burnout and allowing for better workload management across all teams. Other benefits include enhanced collaboration by integrating pricing expertise within the business and contracts organizations, improved efficiency, and increased proposal accuracy as more staff are trained in pricing competencies, ensuring a broader pool of employees can handle last-minute proposal finalizations, leading to more accurate and timely submissions.

This strategic redistribution not only addresses immediate concerns but also fosters a more synergistic environment where knowledge is shared, and skill sets are broadened. By embedding pricing experts within the business and contracts teams, the organization can achieve a more cohesive approach to project management and proposal development, ultimately enhancing the overall quality and timeliness of submissions.

Developing a Cost Strategy Early

To ensure success in competitive solicitations for high-dollar value RFPs, it is crucial to develop a robust cost strategy from the very beginning of the capture process. Winning such solicitations is often determined well before the final RFP is released. A key component of this success lies in crafting a cost

strategy that delivers either the lowest price or the best value in terms of price and features. By initiating a cost strategy on day one of the capture lifecycle, companies markedly increase their chances of achieving the most competitive price or value proposition.

An AI-enhanced cost tool can help develop the cost strategy by allowing a cost analyst and proposal SMEs to work together to estimate a high-level ROM cost that can reveal the cost drivers and identify the key feature trades.

A SME should be able to quickly develop, perhaps with help from using a LLM, a high-level WBS or sometimes a product breakdown structure and provide estimated ROM resources for these WBS items. The AI-enhanced tool enables the saving of the WBS and resource estimates into a system of record (cost tool) for further refinement as the capture lifecycle progresses. These initial ROM estimates provide a starting point for a cost strategy. Using AI tools, the cost analyst or SME can exploit external and internal resources to indicate where there is an opportunity for cost savings against the WBS items. As this work is under CM control, modifications and improvements can be monitored and evaluated.

As the capture lifecycle progresses with more specific information from draft requirements, specifications, and customer interactions through final RFP documentation, the AI-enhanced cost tool can refine the initial ROM estimates with more detailed and precise estimates. This evolving process allows the tool to incorporate new data and feedback, ensuring that cost projections remain accurate and relevant throughout the proposal development.

Leveraging AI tools in this manner not only facilitates more accurate and efficient cost estimation but also enhances the ability to monitor and adapt to changes throughout the proposal development process. By combining the expertise of SMEs with the analytical power of AI, organizations can ensure their proposals are both competitive and aligned with the client's requirements.

Example Cost Strategy Development

A capture team for an innovative small UAV manufacturer obtains information that the government will procure a small counter UAV system (c-UAS) with defensive and offensive cyber capabilities. After kicking-off the capture, a proposal analyst uses their AI-enhanced cost tool that uses the companies past small UAV proposal and historical performance data through an RAG index to create a high-level WBS and resource load. This initial cost model has two WBS elements, Labor and Material below the top c-UAS level. Next the capture SMEs modify this initial WBS into five Level 2 WBS elements and their resources to create an initial ROM. The capture then identifies areas for trade studies and cost reduction initiatives.

After the government held an Industry Day and released draft requirements, the capture team along with c-UAS SMEs and initial trade study results, revised the Level 2 WBS and added 10 Level 3 WBS elements with initial resource loads. This refined cost model provided insight into performing additional trade studies and cost reduction initiatives.

After the release of the draft RFP, a refinement of the WBS and cost estimates commences with the addition of 5 Level 5 WBS elements and 10 Level 4 WBS elements. This detailed breakdown allows the

capture team to allocate resources more precisely and identify areas for potential cost reductions or efficiency improvements. By incorporating these refinements, the team can develop a more accurate and competitive cost proposal that aligns closely with the client's requirements and expectations.

This post draft RFP cost model was compared to the first release of an independent Price-to-Win (PTW) model of the company's two primary competitors. How AI can help with a PTW is discussed later in this paper. The comparison with the PTW analysis showed the need for further cost reductions. Thus, the team embarked on additional trade studies and cost reduction initiatives to ensure the proposal remain competitive.

The release of the final RFP showed moderate changes from the draft RFP, and minimal changes needed to the post draft RFP WBS. The final WBS to be used in the proposal cost volume contained 5 additional Level 4 WBS elements and 6 Level 5 WBS elements. The changes were quickly implemented in the AI-enhanced cost model. Final estimating and Basis of Estimate writing commenced. Since the AI-enhanced cost tool also instantly calculates total cost, the proposal team knew the total cost as soon as an estimator completed their estimate. Final pricing was established as soon as the fee percentage was strategically decided upon by senior executives.

Having SME's do the estimating

An easy-to-use AI-enhanced cost tool allows SMEs to do their own estimating. Often SMEs relegate estimating to junior staff as they do not want to be bothered with finding data, normalizing it, developing an estimate, and writing a BOE. An AI-enhanced cost tool can do many of these functions, provided the company has invested in integrating their historical data into a data structure that the cost estimating tool can access. The AI features allow for easy exploitation of the data and the ability to write estimates back into the tool.

AI tools help technical SMEs by identifying relevant data, suggesting best estimation methods, and performing the estimations. By leveraging advanced algorithms and machine learning, these tools can sift through vast amounts of historical data to identify the most pertinent information. They can also recommend estimation techniques based on the specific characteristics of the project, ensuring that the estimates are as accurate as possible. An example of applying machine learning analysis involves performing both linear regression and random walk analysis on a set of historical data. The machine learning tool then recommends the model that exhibits the highest R-squared (R2) value. This not only simplifies the estimating process but also ensures that SMEs can maintain control over the accuracy and relevance of the estimates, ultimately leading to better-informed decisions and more competitive proposals.

By streamlining these tasks, AI-enhanced tools free up valuable time for SMEs, enabling them to focus on higher-level strategic aspects of proposal development. Additionally, the integration of historical data with AI capabilities ensures that the estimates are grounded, leveraging past experiences and performance metrics to enhance future projections. This approach not only boosts the efficiency and

effectiveness of the estimating process but also fosters a culture of continuous improvement as organizations can learn from each bid and refine their strategies accordingly.

Leveraging AI tools in this manner not only facilitates more accurate and efficient cost estimation but also enhances the ability to monitor and adapt to changes throughout the proposal development process. By combining the expertise of SMEs with the analytical power of AI, organizations can ensure their proposals are both competitive and aligned with the client's requirements.

Risk Assessments

Risk assessment is a critical component of cost proposal development, as it provides decision-makers with insight into the probabilistic range of cost outcomes and the financial implications of uncertainty. Traditionally, this process has relied on separate Monte Carlo spreadsheet tools, manual input of distributions, and independent cost models—often requiring specialized resources and producing limited integration with the broader estimating environment. In contrast, an AI-enhanced cost tool functions as a unified, multi-functional platform—a Swiss Army knife for modern cost professionals—combining estimating, pricing, and risk analysis into a single environment.

By embedding machine learning capabilities into the cost tool itself, organizations can streamline the risk assessment process without sacrificing rigor or granularity. Analysts can select appropriate probability distributions, input parametric ranges for key cost elements, and run Monte Carlo simulations directly within the estimating interface. The tool enables seamless transition from estimating to risk analysis, eliminating redundant data entry and minimizing the risk of version control issues.

Moreover, the system’s ability to perform Pareto analysis and identify the cost elements that contribute most significantly to overall uncertainty allows organizations to focus their attention on the most consequential areas. The result is a more targeted and transparent approach to risk management—one that is traceable, repeatable, and scalable across multiple proposals.

Beyond individual project assessments, AI-enhanced tools offer the potential to build institutional knowledge by capturing and analyzing historical risk curves, actual performance data, and associated programmatic attributes. Over time, this data can inform machine learning models that refine risk assumptions and offer predictive insights, ultimately supporting more strategic decision-making and enhanced proposal competitiveness.

Just as a Swiss Army knife equips a user with the right tool at the right moment, an AI-enhanced cost platform provides estimators and analysts with the capabilities needed to perform robust, data-driven risk assessments—without leaving the estimating environment.

Example of Performing a Risk Assessment

After the C-UAS cost proposal from an earlier Section is ready for executive review, a execution risk assessment is performed on the estimate. The risk analyst goes to the Risk Assessment screens in AI-

enhanced cost tool and performs a Pareto analysis on all the WBS cost elements. The analysis shows that the top six WBS elements account for 82% of the total cost.

The analyst decides to use simple Triangle distributions for the top six WBS elements and establishes reasonable ranges of outcome hours for each by consulting the engineering SMEs. The next inputs the company's established normal distribution values on the direct and indirect rates used in the cost proposal. A final approval review of the risk and opportunity ledger, developed and maintained in the AI-enhance cost tool, throughout the whole capture process is held with the proposal team.

After approval, the risk analyst executes the risk assessment and ML routines perform Monte Carlo analysis on the proposal cost elements, using the supplied distributions. The output of risk assessment is a cumulative distribution S-curve, and a profitability report, showing potential profits at different levels of cost confidence, using the contract geometry.

Next-Generation Analogous Estimating: Equipping Estimators with Data-Driven Intelligence

Building on the foundations established in previous sections—reengineering the pricing function, initiating cost strategies early in the capture process, enabling SMEs to generate estimates directly, and embedding risk assessments into estimating workflows—a new capability is emerging: next-generation analogous estimating. This emerging approach moves beyond static, spreadsheet-based analogs and memory-driven precedent, leveraging structured historical data and applied machine learning to deliver early-phase estimates that are both data-informed and contextually grounded. It represents the next blade in the estimator's AI-enabled Swiss Army knife—extending their ability to develop defensible, adaptable estimates with greater speed and insight, while reinforcing the strategic principles already discussed.

Redefining Analogous Estimating through Applied Intelligence

The goal of this approach is not to replace the estimator, but to give them a smarter, more informed starting point—one that reflects the way projects actually unfold. Leveraging advancements in pattern recognition and historical data modeling, modern analogous estimating methods offer context-aware recommendations while keeping control firmly in the hands of the practitioner. Estimating remains both an art and a science; these tools aim to elevate both.

Current Innovations and Use Cases

Feature-Based Rapid ROM Estimation

Estimators begin with a handful of project descriptors—scope drivers, system types, key constraints—and the tool retrieves analogous historical efforts based on feature similarity. Rather than relying on memory or anecdotal precedent, cost ranges are generated based on real project data, allowing users to adjust inputs and immediately see how the estimate evolves. The estimator is in control; the AI simply accelerates and strengthens the foundation.

Task-Level Analog Estimating with Confidence Scoring

In cases where detailed historical data is available, models can suggest labor and material estimates at the task level. Each recommendation includes a confidence score, signaling the strength and relevance of the match. This transparency reinforces the estimator's decision-making process, allowing them to consider the data's weight rather than accept outputs at face value.

Granular Estimating for High-Fidelity Historical Libraries

Organizations with mature cost data libraries can unlock ultra-granular estimating capabilities. Here, machine learning models identify historical task-level parallels, normalize values, and aggregate them into higher-level WBS elements—creating a traceable path from detailed analogs to top-line bid summaries. It's a powerful function for those who've invested in cost knowledge management and want to extract its full value.

Beyond the Proposal Phase: Broader Applications

While the current focus is on improving proposal-phase estimates, the broader utility of this approach is evident. Potential future use cases include:

- Forecasting and Estimate-at-Completion (EAC) updates during project execution
- Real-time Monte Carlo simulations driven by historical task variability
- Dynamic, model-based baselines that evolve as actuals are received

Ongoing Development and Collaboration

This capability is in active development, with efforts focused on aligning historical data sets, refining training strategies, and building interfaces that are both credible and intuitive. Ideal early adopters may include organizations with well-structured estimating histories and an interest in exploring collaborative, open-improvement models. A baseline version of this methodology is targeted for demonstration at the upcoming ICEAA conference, with plans to invite technical review and peer feedback.

Takeaway Thought

Estimating has always been a blend of science and intuition. With the right models and the right data, we can finally provide estimators with tools that respect both—extending their capabilities, not replacing them. Like any great Swiss Army knife addition, this innovation expands what's possible, while keeping trusted hands on the handle.

Other Types of AI-Enhanced Tools for Proposals

While AI-enhanced cost estimation tools are pivotal in transforming the proposal process, several other AI-driven tools can also play a crucial role in enhancing proposal development. These include:

- PTW analysis can be significantly enhanced by AI tools. Since PTW relies on open-source material, a current LLM can assist analysts in gathering competitive intelligence (CI) about potential competitors. Machine learning tools that integrate PTW models with AI-enhanced cost tools can offer valuable competitive assessments. These AI-driven PTW analyses provide a

more comprehensive understanding of market dynamics, enabling organizations to position their bids more strategically.

- Technical volume text drafting: Natural Language Processing (NLP) or LLM tools can analyze and extract pertinent technical information from large volumes of text, helping to identify key requirements and compliance issues in RFPs. They can also assist in drafting and refining technical proposal content, ensuring clarity and coherence.
- Sentiment Analysis Tools: By gauging the tone and sentiment of client communications and feedback, these tools can help proposal teams tailor their responses to align with client expectations and preferences.
- Automated Proofreading and Editing Tools: These tools enhance the quality of proposals by identifying grammatical errors, ensuring consistency in terminology, and improving overall readability.
- Compliance Checks: NLP tools offer a significant advantage to proposal teams, particularly in compliance checks against RFP documentation. These tools can swiftly analyze large volumes of text, extracting critical requirements and stipulations that must be met. By comparing the proposal content with the specifications outlined in the RFP, NLP tools can flag any discrepancies or missing elements, ensuring that the proposal adheres to all necessary compliance standards.
- Proposal Scoring: NLP and RAG tools can use the Section M criteria to perform a scoring of their technical volumes and identify areas for improvement. These tools can analyze the criteria set forth in Section M, which typically outlines the evaluation factors for award, such as technical approach, management plan, and past performance. By comparing the proposal content against these criteria, NLP and RAG tools can generate a detailed assessment that highlights strengths and weaknesses, offering actionable insights for enhancement.
    - For example, if the Section M criteria emphasize the need for a robust risk management plan, these AI tools can evaluate the proposal's risk management section for comprehensiveness and effectiveness. They can identify gaps or weaknesses, such as a lack of mitigation strategies or insufficient detail on contingency plans and suggest improvements to align more closely with the evaluation criteria.

Overall, integrating these AI-enhanced tools into the proposal process can significantly improve efficiency, accuracy, and the likelihood of winning bids.

Conclusion

Summary

The evolution of cost estimation demands tools that are as adaptable and multifaceted as the challenges they are designed to address. The AI-enhanced cost estimating tool outlined in this paper represents a significant step toward that future. More than a collection of features, it serves as a strategic, all-in-one platform—resembling a Swiss Army knife for the modern estimator—integrating advanced analytics, natural language processing, intelligent data structuring and data-driven analogous estimation.

By replacing disjointed processes with a cohesive, AI-enabled solution, organizations can reduce manual errors, streamline cost development, and support real-time decision-making. These tools empower subject matter experts to estimate independently, strengthen early-stage cost strategies, and incorporate risk assessments directly within the estimating environment. The incorporation of the concept of next-generation analogous estimating further extends these capabilities, enabling rapid, data-informed ROM estimates and task-level forecasting based on historical precedent, complete with confidence indicators that guide estimator judgment without overriding it.

Though challenges remain, including data readiness, integration effort, and organizational change, the benefits of adopting this toolset are substantial. Those who embrace this model will be positioned not only to respond more effectively to complex proposal demands, but also to lead with agility, accuracy, and strategic insight. In doing so, they shift from reactive, patchwork estimating to a cohesive, AI-driven approach—equipping cost professionals with the precision, versatility, and foresight required to succeed in the AI era.

Challenges

Adopting an AI-enhanced cost tool within an organization can present several challenges. One significant challenge is organizational gamesmanship. Members of the decision-making team may resist the implementation of a new tool due to concerns about the impact on their jobs or performance bonuses. This resistance can stem from fears of reduced control, job redundancy, or changes in performance metrics.

I addressed some of these issues in a paper presented at the 2022 International Cost Estimating and Analysis (ICEAA) workshop[1], highlighting how organizational dynamics play a part in developing Basis of Estimates. The reluctance to embrace new technologies can slow down progress and prevent companies from benefiting from enhanced efficiency and accuracy.

Another challenge is the investment required to develop a comprehensive historical database for the AI-enhanced tool. This process often involves combining data from various sources, such as an ERP accounting system and a project control earned value management system. Integrating these data systems can be complex, time-consuming, and costly, requiring significant resources and expertise.

As mentioned earlier in this paper, training ML models requires high-quality, diverse, and well-preprocessed data to ensure accuracy and efficiency, which is a large challenge in the cost estimating world. A brief discussion of what it takes to create data for training a ML model. The process begins with data collection, where structured (e.g., databases, spreadsheets) and unstructured data (e.g., text, images, audio) are gathered from multiple sources. Next, data preprocessing is crucial to clean, normalize, and transform raw data into a usable format by handling missing values, removing duplicates, and standardizing features. Feature engineering plays a key role in improving model performance by selecting, transforming, or creating meaningful input variables. Once prepared, the dataset is divided into training, validation, and test sets to optimize model learning and prevent

[1] Burney, Sandy (2023), The BS in BoeS: Oh the Games That are Played, *The Journal of Cost Analysis and Para metrics*, 11(1), 89-104. https://www.iceaaonline.com/wp-content/uploads/2023/04/JCAPv11i1042423.pdf

overfitting. Various ML algorithms, such as supervised, unsupervised, or reinforcement learning, leverage this data to recognize patterns, make predictions, or automate decision-making. Continuous model evaluation and retraining with new data ensure the ML system remains accurate and adaptable over time.

If Angus MacGyver were navigating today's cost estimating challenges, he wouldn't reach for a tangle of spreadsheets and disconnected risk tools—he'd deploy a fully integrated, AI-enhanced cost platform, his modern-day Swiss Army knife. With built-in risk analysis capabilities, he'd start by identifying the key cost drivers through a quick Pareto analysis, apply well-informed distributions with input from SMEs, and execute a seamless Monte Carlo simulation—all without leaving the estimating environment. By keeping everything connected and configuration-managed from the start, MacGyver wouldn't be rushing to stitch together last-minute inputs. Instead, he'd deliver an S-curve and profitability report that gives leadership a clear view of execution risk and margin—precisely when it matters most. The lesson? With the right multi-functional tool in hand, even the most complex cost challenges become manageable.