# Revolutionizing Enterprise Solutions with AI: A Whitepaper on a Novel Approach

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**Bottom Line:** The innovative approach to leverage AI described herein represents a significant development in the use-cases of AI technology within enterprises. By learning domain knowledge from experts and leveraging large language models and deep neural networks to develop multi-dimensional graph databases capturing variable relationships and causality, the AI gains the novel capability to automate reasoning and generate constraints for optimization problems. It differs from traditional AI by integrating domain knowledge for reasoned data selection, thus providing comprehensive problem-solving approaches and enhancing operational responsiveness. It has already shown remarkable efficiency in applications like order and procurement management and workflow optimization. Looking forward, this novel application of AI promises to revolutionize workforce management, enhance supply chain and procurement, and streamline supplier collaboration. Moreover, it could support revenue growth, margin expansion, human capital value extraction, and a shift towards knowledge-centric operational models.

## How It Works:

This novel approach to AI is designed for continuous learning and improvement, drawing on domain knowledge and insights from experts much like a new employee being trained. It utilizes large language models and deep neural networks to create a multi-dimensional graph database capturing variable relationships and causality, crucial for areas where data might be scarce or unreliable. The foundation of the AI system is subject matter expertise which informs its automated reasoning process consisting of three layers: Principal Causal Model (general principles), Rational Causal Model (enterprise-specific knowledge), and Structural Causal Model (knowledge and features used to solve specific problems).

## Comparisons To Traditional AI:

Unlike traditional AI which primarily relies on statistical analysis, this next-gen AI integrates domain knowledge allowing for reasoned data selection and a more comprehensive problem-solving approach. It's versatile and efficient, capable of optimizing processes while ensuring computational feasibility. The AI is capable of identifying and suggesting ranges for key variables, making the optimization process more efficient and reducing reliance on in-house experts. It's able to digitize tasks previously performed by human experts, identifying factors that affect efficiency, thereby enhancing operational responsiveness.

## Proven Use Cases:

The AI demonstrated remarkable efficiency in order management, reducing order throughput time from days to seconds and substantially increasing "touchless" orders. It also optimized procurement management by adjusting sourcing strategies, leading to significant cost savings. The AI demonstrated its ability to balance multiple priorities simultaneously and optimize processes by identifying and prioritizing impediments in the workflow. Its applications were shown to be adaptable across domains and capable of grasping complex concepts, such as the "value in use" of products.

## Opportunities & Impacts:

AI has the potential to revolutionize workforce management by assigning tasks and offering training based on worker profiles, as well as enhancing supply chain management by foreseeing issues and optimizing sourcing strategies. It promises improved product quality, minimized operational disruptions, and strategic alignment with market trends. Future AI could also streamline supplier collaboration through real-time tracking and expedite onboarding. Traditional ERP systems could be reduced to transaction record keepers, and the overall economic impact of AI adoption could range from boosted revenues and reduced costs to greater extraction of value from human capital and a fundamental transformation towards knowledge-centric operational models.

## How It Works

Learning and Improving

This novel approach to AI is built on the principle of continuous learning. Much like training a new employee, it's fed with domain knowledge and insights from subject matter experts, then tasked to apply this knowledge in practical scenarios. In practice, the engine can import PDFs of college coursework, industry whitepapers, and transcribed interviews to learn in the same way humans do. It can learn from its actions and past challenges, adapting and improving over time. For instance, if its recommendations in order management are not adopted by the customer solutions analyst team, it learns from these outcomes and adjusts its future decision-making process accordingly.

The Role of Large Language Models and Neural Networks

The system operates on powerful technologies such as large language models and deep neural networks. These components enable the creation of a comprehensive multi-dimensional graph database that captures variable relationships and their causalities. This causality-driven approach proves critical, particularly when data is scarce or unreliable, demonstrating the importance of balancing statistical modeling and causal understanding in AI.

Building Blocks

The AI system's foundation is rooted in subject matter expertise. The previously mentioned importation of college coursework, etc. allowed the AI to reach ~60% of the knowledge it needed to achieve optimal modeling and problem solving. The remaining capabilities gap was solved by the importation of subject matter expertise. This expert knowledge helps in forming the principles of the causal model, enabling automated reasoning that leads to an optimal model.

Automated Reasoning

The system's reasoning process draws from a variety of knowledge types, from scientific equations to expert insights. This mechanism consists of three layers:

1. Principal Causal Model: This layer is taught the general principles of a given domain (like supply chain management), which includes rules, guidelines, and scientific principles necessary for the system to understand and address issues.
2. Rational Causal Model: This layer introduces enterprise-specific knowledge, performing automatic feature engineering by deriving relevant features from the knowledge itself. These features help the AI system to understand and determine critical factors in decision-making or predictions.
3. Structural Causal Model: This layer uses the processed knowledge and features to solve specific problems. It's designed to know what data it needs to optimize solutions, and will request it if not readily available. This is where the model becomes actionable, suggesting optimizations, identifying inconsistencies, and providing potential solutions.

## Comparisons To Traditional AI

<u>Beyond Big Data</u>

Traditional AI, which largely operates on statistical analysis, faces several limitations, particularly in sectors like manufacturing, where the need for terabytes of high-quality, well-structured data is unmet. This “next-gen” AI integrates domain knowledge, allowing it to reason and selectively target relevant data in settings where data is poor (a mix of high- and low- frequency data, unstructured data, and inconsistent data across facilities). Moreover, its ability to reason and theorize the additional data or data changes it needs to increase optimization significantly enhances its capabilities.

<u>A Comprehensive Approach</u>

Unlike the conventional 'point solution' focused AI models that aim to solve individual problems, this system adopts a more holistic strategy. It assimilates knowledge from a diverse range of disciplines, thus broadening its problem-solving reach.

<u>Versatile Problem Solving</u>

The unique methodology of this AI engine centers on knowledge-based learning and application. Since the engine is taught subject matter expertise rather than just being fed data, it offers versatile problem-solving capabilities that can be deployed across any domain. This supports a use case transformation from only automating things that are predictable and repeatable to automating things that can be taught.

<u>Optimization and Computational Feasibility</u>

In the classic business school case study of WebVan’s attempt to perfect grocery delivery, the failure point was underestimating the computational intensity required to productively create optimized delivery routes. A critical differentiating factor of this new approach to AI is that the solution not only optimizes processes but also ensures the computational feasibility of this optimization. The system's automated ability to establish constraints on the optimization model is a distinguishing feature that sets it apart.

<u>Overcoming Constraints</u>

There are significant complexities involved in multi-objective optimization, particularly when personal data or other crucial information is scarce. The actual optimization is often the easier part, with several engines available to execute it. The real challenge lies in autonomously generating constraints for the optimization problem.

<u>Automated Reasoning and Domain Knowledge</u>

Training the AI engine with enterprise-specific knowledge and functionality enables the system to establish necessary constraints for running an optimizer. It can identify and suggest ranges for crucial variables, making the process more efficient and reducing reliance on in-house experts. With automated reasoning, the system can digitize tasks that were once performed by human experts, identifying key factors that affect the efficiency of business processes, like supply chains. These factors become the constraints for the optimizer, significantly enhancing operational responsiveness.

## PROVEN USE CASES

Streamlined Order Management

In a recent demonstration, an industrial manufacturer demoed an impressive application of their AI system in order management. Standard orders are processed routinely, but the AI uses its expansive knowledge base to solve novel issues. Orders are assessed against customer, enterprise, and supply chain data, facilitating problem-solving that traditional systems couldn't achieve. This implementation has transformed the efficiency of the process, reducing order throughput time from 2.92 days to 15 seconds and exponentially increasing the percentage of "touchless" orders from 10% to 91%. This system also equips the customer solutions team with comprehensive order details and unveils previously undetectable internal inefficiencies, targeting a 10-20% reduction in these inefficiencies.

Efficient Procurement Management

Another practical deployment of AI optimized the sourcing of commodities for production. $1.5B of costs for a single input was targeted across three facilities. Preliminary results already show considerable savings on costs from 8-20%, varying by supplier and specific attributes. Leveraging the same underlying tech used to build the order management model, they adapted the AI's knowledge base to comprehend complex areas such as chemistry and mechanical engineering. This approach enabled the AI to grasp the total value gained from a product, termed as "value in use," instead of solely focusing on the purchase price.

Balancing Priorities

The AI system developed proved its ability to juggle multiple priorities simultaneously. This capacity was exhibited in a scenario where the AI had to choose between a late delivery with a penalty or an on-time delivery with potential impact on the overall order batch's timeliness. The AI proposed various options and illustrated each decision's operational impact, allowing the team to make the most informed decision.

Process Optimization

The AI model was tasked with analyzing several manufacturing processes, successfully identifying 26 workflow impediments. Significantly, the model found that 5 of these impediments were causing a 90% of the issues, showcasing the AI's ability to detect and prioritize problem areas for maximum operational improvement.

## Opportunities & Impacts

Workforce Modernization

AI has the potential to revolutionize employee task assignment and training, personalizing these areas based on worker's skills and qualifications. With an increasingly youthful workforce, AI could expedite the onboarding process, and integrate safety and production data to advance from an asset-centric to a knowledge-centric approach.

Supply Chain and Procurement Enhancement

Anticipatory supply chain management is on the horizon with AI systems. They could foresee potential problems, balance sourcing strategies optimally, and speed up market response, contributing to revenue growth.

Quality and Efficiency Augmentation

AI promises improved product quality, reduced operational disruptions, and strategic purchasing alignment with market trends. This efficiency surge could substantially reduce costs and protect businesses from potential losses.

Collaborative Supplier Engagement

With data and AI investment, supplier collaboration could be more effective. Real-time tracking of production changes, KPI performance assessment, and quicker supplier pre-qualification could become the norm. An interactive supplier portal could accelerate onboarding, reducing trials and cutting operational costs.

ERP System Transition

While not rendering traditional ERP systems obsolete, future AI systems could change their role significantly, reducing them to transaction record keepers. This could have implications for companies like SAP & Oracle as businesses increasingly seek AI-enhanced operational efficiency.

Financial Impact

The adoption of AI could bring a wave of economic impacts, from boosting revenues through quality and efficiency gains to cutting costs by streamlining operations and supplier onboarding. This includes the ability to increase the ROI of human capital investments by leveraging the knowledge of internal subject matter experts more efficiently, and retaining that critical expertise even after an employee has left the company. The capacity to swiftly respond to market changes, preempt supply issues, and automate forecasting could further amplify profitability and drive business growth. With these elements in play, the successful adoption of these AI models could mark a fundamental transformation of operational models, ushering in an economy-wide shift towards knowledge-centric business processes.