Keelvar

The Rise of AI Agents in Enterprise Procurement

How intelligent autonomous systems are taking shape and already transforming sourcing at scale.

Table of contents

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Previously a lecturer in Artificial Intelligence in University College Cork's Computer Science Department, Alan graduated University with a PhD in Computer Science with research that focused on combinatorial auctions. Alan founded Keelvar in September 2012 when he left the University to commercialize advances in AI for procurement teams.

Alan's specialist knowledge in Optimization, Game Theory and Mechanism Design gives Keelvar an edge in terms of innovating with offerings that exceed competitors' technical capabilities. This enables Keelvar to define an entirely new category of the solution, putting Keelvar in an ideal position to lead this new category that Keelvar has called Autonomous Sourcing.

Executive summary

AI Agents are transforming enterprise procurement, enabling autonomous workflow execution and self-learning capabilities. This shift is driven by the need for agility, cost-efficiency, and data-driven decision-making in the face of complex challenges like price volatility and data overload. Keelvar – a leader in SaaS procurement solutions – is at the forefront of this evolution, witnessing a rapid increase in agent-operated sourcing events.

Currently, agent-driven sourcing handles a significant portion of tactical and tail spend, while strategic sourcing remains largely human-operated. However, cycle times are collapsing across all sourcing event sizes, and suppliers are showing increased engagement with faster, more efficient processes. Successful AI Agent implementation requires careful planning, including selecting a "dream team" with AI and procurement expertise, prioritizing spend categories, and adopting an agile, iterative approach. Key components of effective AI Agent solutions include a robust workflow engine, a no-code workflow design, and an API-driven architecture. When evaluating vendors, it's crucial to be wary of those merely wrapping LLMs around features without true AI capabilities.

Looking ahead, AI Agents are expected to become even more sophisticated, with multi-agent systems and near-instantaneous negotiations. Businesses should start with a significant use case to demonstrate value and build momentum for broader adoption.

Introduction

The present era is one where agility, cost-efficiency, and value creation from Procurement are of paramount importance. Large enterprises face a multitude of challenges, from price volatility to transportation constraints, and their legacy suites are hindering fast, informed decision-making. These external challenges are also combined with the ever-increasing flood of data that, if used appropriately, can unlock savings, speed and better decision-making. The winners in this era are those that can embrace complexity with intelligent systems that thrive on data and facilitate rapid action and decision-making. Winners are already emerging but it's not too late to be in the winners' circle as the era of AI Agents and intelligent systems is becoming a reality.

Keelvar is pioneering the integration of AI Agents into sourcing workflows. It has always been our vision as a company since we emerged from an AI research lab in 2012 to support both human and software agent users. The underlying architecture for AI Agents leans on structured data as well as unstructured data. The utilization of structured data is crucial to success. This white paper explores the opportunities presented by AI Agents that embrace numerous relevant subfields of AI to solve the grand challenge of enabling autonomous workflow execution. To truly solve this challenge it is imperative that these agents 1) perceive when to act, 2) autonomously execute a multi-stage workflow with intelligent reasoning and 3) apply learning to adapt over time. The aim is to have agents that exceed human expert performance in quality of execution, speed agility and operational efficiency.

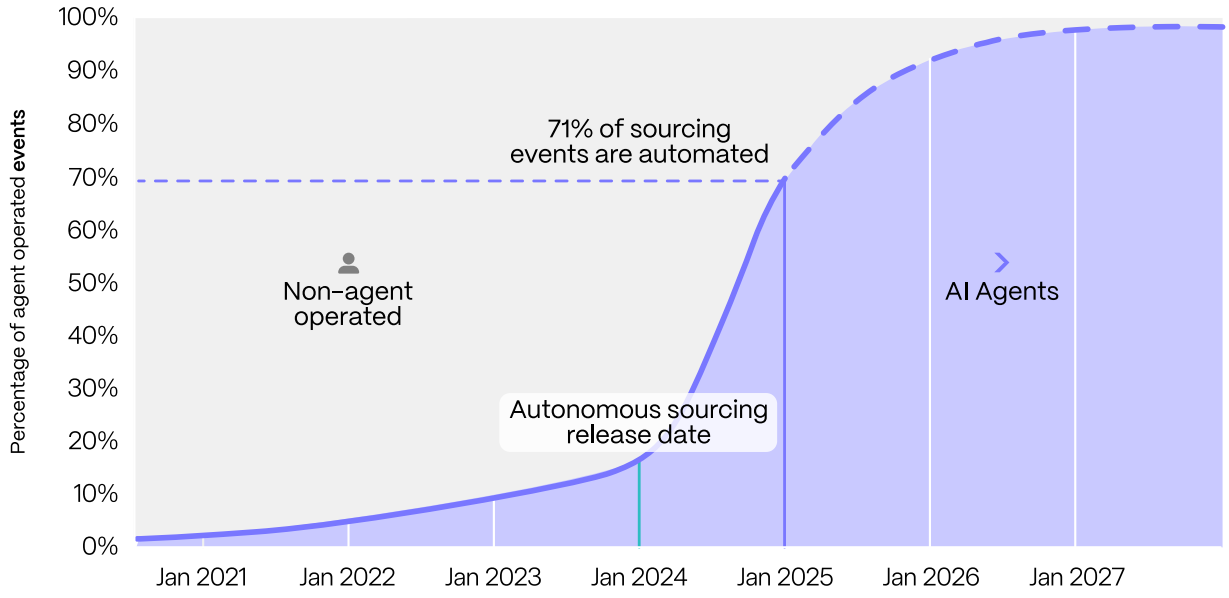
We have learned many important lessons from some very successful rollouts since launching our Autonomous Sourcing product, and this white paper provides guidance on how to achieve success, quickly.

Seismic shifts are already well underway

Since Keelvar first launched sourcing automation in 2020, several adoption cycles were experienced and learnings through failures and successes informed product design aimed at maximizing speed and success rate. Keelvar initially developed custom scripts to automate workflows. This informed the key automation features and controls that were essential for a self-service solution. Subsequently, in the period 2022-23 a no-code solution that facilitates self-service creation of agents to automate sourcing processes was built and integrated via API with the underlying sourcing workflow engine. Initially, these were not self-learning or adaptive but did rely upon optimization technology for award decision-making.

This launch of no-code workflow design and automation was to all customers in February 2024 and acted as a catalyst for faster adoption of Autonomous Sourcing. Customers began experimenting with our workflow designer, testing and then scaling agent-driven sourcing. We quickly passed the 50% milestone in agent-led sourcing versus human-operated sourcing. An S-curve is clearly observable and indicative of a rapid evolution towards agent-driven sourcing.

Percentage of events that are agent-operated in Keelvar

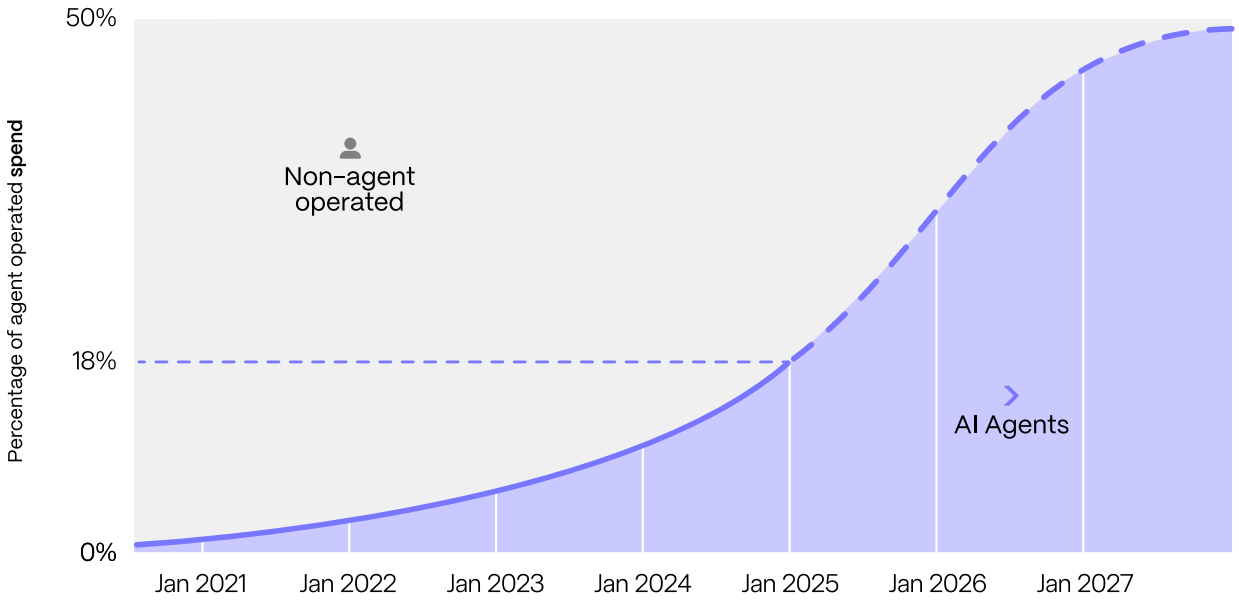


Adopters of autonomous sourcing tend to test the approach on a single category with lower volume and fewer stakeholders initially. Gaining acceptance of change is more easily managed when there are fewer requesters and operational stakeholders to convince of the change. Once this is demonstrated successfully, a scaling plan is usually developed for adjacent spend categories with similar workflow patterns. These often have larger volumes of spend and sheer number of bid events required. Throughout 2024, we witnessed the scaling processes for large enterprises who transformed the speed, agility and performance of their sourcing in 6-8 months. When anyone sees such a stark change, it is natural for readers to ask the following questions.

- Will sourcing activities become software Agent-operated?
- How are people's roles and responsibilities changing in this new world?
- Just how fast will sourcing become?

To answer these questions it is useful to inspect the following data patterns on Keelvar's platform.

Percentage of spend sourced by autonomous agents

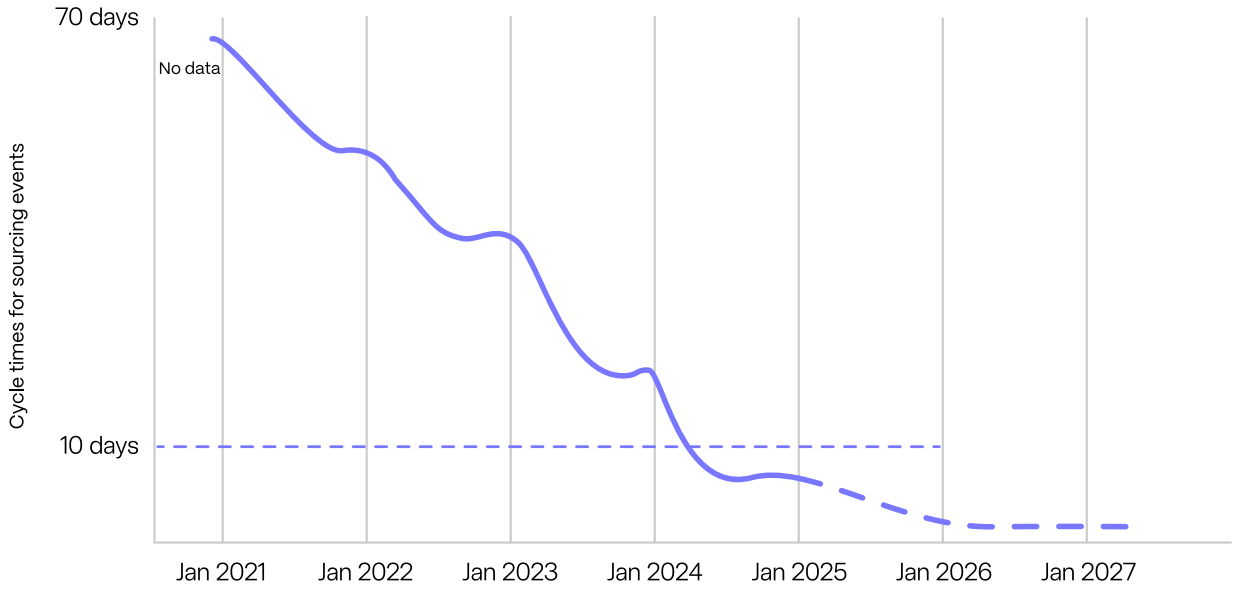


The fraction of sourcing events that are agent operated is clearly trending towards a high percentage of all sourcing events. We estimate that the asymptote (or the long run 'cap') will be approximately 95-97% of sourcing events. However, the figure above paints an interesting picture of the fraction of spend that is being sourced by software agents versus people.

It should be clear from this chart that there is a heavy focus on lower spend events for autonomous sourcing. With 18% of spend being sourced by agents, even though 71% of sourcing events are agent operated, it is clear that the tactical and tail sourcing events are dominating automated sourcing activities. Conversely, 82% of spend that is managed is concentrated in 29% of the sourcing events in Keelvar that are manually operated using Sourcing Optimizer (SO).

So the largest and most strategic sourcing events are clearly being kept for slower paced and closely controlled negotiations. This makes sense as there is not a need nor an appetite to fully automate a business' largest negotiations that can benefit from establishing mutual trust and empathy between Procurement and Suppliers. Automation saves so much time in tactical and tail spend that it is possible to invest more time in strategic sourcing and optimization, meaning both parties can afford to spend more time on developing strategic partnerships, assessing scenarios and tradeoffs in SO and debating win-win approaches to value creation.

Collapsing cycle times for sourcing events



Sourcing is speeding up as we see a shift towards automation. The cycle time of sourcing events is falling quickly and this is set to continue. Although this is, in part, driven by the movement of customers from strategic sourcing focused usage of Keelvar to also utilizing Keelvar for tactical and tail sourcing events, the acceleration is material across all size of sourcing events. Anecdotal evidence from customers points towards autonomous sourcing cutting cycle times by 90% for most sourcing processes that were manually executed on other eSourcing platforms previously. Suppliers have a preference for customers that operate fast and efficient sourcing processes so the number of bids per sourcing event has also increased with automation. So the response rates on rapidly executed sourcing events relying on autonomous agents has increased and not decreased as some feared.

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AI Agents for sourcing: Key requirements

AI Agents perceive and act autonomously. They also learn from experience. For an enterprise to be agile, it needs AI Agents to perceive when the conditions are right to take an action. Sometimes this is simple and depends on one signal that triggers sourcing but more often, there are certain combinations of conditions that occur to determine when it is the right time to commence a sourcing activity. Furthermore, the volume of goods or services required can vary and perceiving when and how much to source is important. Intelligent systems can learn these conditions and adapt as demand and markets change.

1. Perceive: When to source and intelligent triggering

If an organization prioritizes speed as an imperative; then this step is important. AI Agents can deliver greater agility than humans because they can monitor for signals and even the right combination of signals to trigger action. A key aspect of this perception for when to act is to have integrations with systems that offer a live feed of data. This can be exogenous (external) or endogenous (internal) feeds that inform the state of the world and key factors that influence knowing when to act.

In the context of sourcing, triggers for when action is required are classified in two distinct buckets.

1. **Exogenous** factors are outside your control and refer to general conditions and uncertainties that need to be monitored. Examples include:
    a. Market prices diverging from contracted rates
    b. Leading indicators that correlate with commodity price movements, such as Oil
    c. tariff changes that alter the costs of import/export and require alternative supply chain reorchestration
    d. Weather incidents that can impact demand or supplies

2. **Endogenous** factors are influenced by internal changes e.g.
    a. Contracted rates expiring
    b. Supplier reliability declining
    c. New product launch that is expected to fuel a demand spike
    d. Labour challenges that might curtail production and motivate sourcing of alternative third party capacity

AI Agents need to be integrated with systems that inform timing of sourcing. Many potential signals or triggers for sourcing, such as weather feeds or market indices, are publicly available via a range of REST APIs. Some others, such as tariff changes, don't necessarily have structured data feeds we can rely upon and therefore may require other approaches such as LLM Agents that parse unstructured data.

AI Agents should perceive when the optimal time to act occurs and should be *more agile in responding than even human experts.*

Initially AI Agents can apply simple rules-based approaches that are triggered on one or two critical factors. But we can expect that over time, increasingly sophisticated models that have demand forecasting, supply elasticity, risk measures and sensitivity analysis will be applied to gain an edge over competitors. That evolution will be fastest in domains where agility and speed are critical factors. But over time it will extend to most spend categories when the cost of rolling it out becomes low and the benefits are substantial.

2. Act: Execution of multi-stage workflows

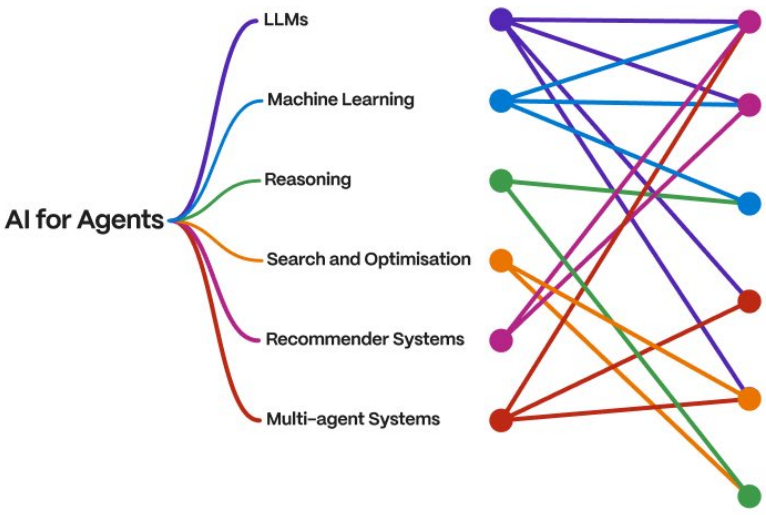
Once AI Agents have been set up to perceive when to act, the next step is ensuring they can operate multi-step workflows autonomously. Getting jobs done from end to end is the essence of value delivery. Although AI Agents are sometimes mistaken for an 'evolution' of LLMs and GenAI, their value is not derived from agents that output a 'strategy' for sourcing teams or humans to follow. Instead, AI Agents must act upon intelligence by triggering multi-stage sourcing processes using a chain of reasoning that conditions decisions at each step based upon what it learns in the previous step following engagement with suppliers. Decisions must be made with a high degree of confidence so that the process can be trusted to be fully automated end to end. Mistakes in sourcing can be costly so unreliable language models are not appropriate for executing processes under the hood. Instead, structured data with taxonomies, error correction and point of entry for suppliers, precision on quantified value drivers and optimization across cost and non-cost objectives should be the bar that needs to be met before considering trusting AI Agents.

The execution of sourcing processes to as high a standard as a human expert would conduct the negotiation is what AI Agents must be measured against.

Too many vendors sell 'actionable intelligence' i.e. a text file to read, parse and take action from, as a panacea when in reality it just creates another job to add to the list of over-worked Procurement and Supply Chain team members. Removing tasks that can be automated from people's workload and getting jobs done faster is what drives transformation.

The challenge here for software vendors is non-trivial; executing each stage of the sourcing process requires different skills. Just as different aspects of human intelligence are needed at different stages, so too do we need to lean on different subfields of AI to ensure a reliable end to end negotiation process in every setting that agent may encounter. To understand how AI Agents need to autonomously execute on workflows, it is important to break down the workflow into its constituent parts.

1. Design the mechanism for the competitive process
2. Choose and invite the right suppliers to compete
3. Elicit necessary structured data from suppliers, including quality assurance and cleanliness
4. Computing alternative scenarios including tradeoffs
5. Iterating with Suppliers by sharing feedback or targets and facilitating timely updates
6. Selecting the award decision and communicating it with Suppliers
7. Generating reports and providing an audit trail



Task	Best Practice Enabled by AI (Examples)
Design Event	Select and fine-tune event process and timing.
Select Suppliers	Analyse data to identify suppliers based on relevance, performance and enagement.
Validate	Ensure input data quality for seamless automated execution
Communicate with Suppliers	Enable instant, expressive and accurate information flows for fully informed, automated negotiation.
Bid and Negotiate	Implement mechanisms that foster competition and rapidly converge on win-win outcomes.
Evaluate and Analyze	Infuse all relevant information and consider manifold business scenarios to allocate awards optimally.

The steps above require various subfields of AI in order to execute a process to a standard that matches or even exceeds human expert levels. The following is a non-exhaustive list of the AI technologies required to have an intelligent system that is reliable, adaptive and continuously learning the best process to execute for each job.

- Mechanism Design to inform the best process for the job.
- Large Language Models (LLMs) to match natural language intake to structured data ingestion flows.
- Recommender Systems to know whom to invite.
- Logical Reasoning to infer the soundness of requests.
- Search and Optimization to find the best scenarios to choose from.
- Multi Agent Systems (MAS) to support instant machine to machine negotiations.

The key point, however, is not the wide range of technologies required to form AI Agents for sourcing but instead that building a reliable and trustworthy solution is hard. It takes years of foundation digging so procurement leaders shouldn't expect any organization solely leaning on LLMs to satisfactorily solve the grand challenge of machine to machine negotiations. Instead, it requires a tech company that is committed to such a vision specifically in the domain of procurement that will provide AI Agents that can perform all the required tasks end to end in a successful sourcing process.

3. Learn: Continuous improvement and adaption

Markets do not stand still. A sourcing process that worked well last year, or even last month, may not work so well today. So many fundamental drivers of markets can change quickly and impact the effectiveness of any sourcing process. Just a few examples of unpredictable changes that motivate the need for continuous learning and adaption include the following:

- A weather event impacts supplier operations or logistical pathways to those suppliers.
- A financial collapse at a supplier or even a second tier supplier reduces capacity.
- A war or terror event knocks out a regional supply base.
- Suppliers go out of business or decide to partner exclusively with your competitor.
- Your demand spikes and existing suppliers lack the elasticity to respond adequately.
- Regulatory changes demand standards that nullify existing options.

Black swan events abound in the modern age and the most successful businesses are those that adapt quickest. Learning is a foundation for adaptation and resilience. AI Agents only exceed human expert performance if they can autonomously learn from experience, self-determine experimentation strategies and converge on equilibria that conform to sourcing excellence, given the reward function that informs that objective. If the learning is sophisticated enough to also lead to robust outcomes that mitigate the potential damage of unknown future incidents, then it not only improves agility but also serves to provide **anti-fragility**, which is somewhat of a holy grail for supply chains.

The forms of learning in AI Agents for sourcing are as follows:

Graph based Learning for Recommender Systems to understand supply networks and relevancy of suppliers capabilities to buyers with similar needs.

Reinforcement Learning for Empirical Mechanism Design so that bid processes evolve and learn which sourcing strategies are best in relevant geographies and markets.

Supervised Learning

- → Classifiers for configuring fields in bid sheets to automate type setting, visibility, mapping etc.
- → Dimensionality Reduction for producing low dimensional vectors (embeddings) for the learned representations of suppliers. This is important for supplier recommendations and ensures relevancy given co-bidding matrices that infer competitive overlap.

Overall, learning is essential for continuous improvement because the alternative is gradual decay. It ensures that when firms go to the effort of investing in a technology platform that it continues to move with the times and add increasing value year over year.

Red flags when assessing AI agent solutions

Many vendors are tempted to oversell what they do and claim AI or Agentic capabilities. Some are bandwagon jumpers who are wrapping an LLM solution such as OpenAI or DeepSeek and thus relying on natural language for inputs and outputs. These types of thin wrapper solutions will not solve any material challenges for enterprises because the cost of making mistakes in enterprise procurement is high and LLMs produce lots of errors. Furthermore, they don't have multi-stage reasoning or deductive logic that is essential for intelligent decision-making. However, they can provide plausible outputs that look good in short demonstrations so many enterprises are trialling toy solutions that fail because they lack depth.

LLM centred agentic AI will never work for execution of a sourcing process to a reliably high standard.

Large language models were designed to predict tokens given a prompt but don't have any understanding of what these tokens mean. There is no model of the world or chain of reasoning despite the outputs appearing plausible at times. The outputs look plausible because they are regurgitating something that looked similar in the past but might be utterly irrelevant or inaccurate for the case at hand. The more specific the challenge, the more likely that nonsense will be produced. Here is a non-exhaustive list of some signs that should raise red flags when evaluating tech vendors who claim to offer agentic AI capabilities:

Team

There needs to be a team that blends core AI skills with knowledge of sourcing and procurement. Intelligent systems require knowledge from both spheres in order to build systems that can autonomously execute processes in sourcing. If there aren't adequately skilled professionals with a background in AI then this is a sign that they haven't built any AI themselves but are just leaning on LLMs for AI enhancement rather than building an intelligent agentic system. If the team lacks experienced professionals with a background in procurement and supply chain then the tools are likely to not support a broad range of spend categories or industries.

Breadth of application

Try to understand how the solution will work in a range of use cases that match your business core requirements, rather than being directed by a vendor to start with a specific use case. A common failing of immature systems is that they've been designed to address just one or two narrow use cases and fall over once you step outside those boundaries.

Synchronised negotiations

A key imperative for sourcing is to simultaneously negotiate with multiple alternative suppliers in parallel. This gives leverage and options. Any solution that only supports single threaded chat-based negotiations will not provide you with leverage in negotiations to get better terms. They are much easier to build but far less relevant for meaningful applications.

Supporting strategic and non-strategic categories

Every business has different views on the spend categories that are strategic and non-strategic. This can also change over time as the business evolves or acquires other businesses. Ensuring solutions can automate tactical sourcing as well as support complex strategic sourcing is necessary if you wish to avoid systems bloat where too many solutions are doing too many niche jobs.

Conclusion

AI Agents represent a paradigm shift because they combine the efficiency of automation with the intelligence and adaptability of human-like decision-making. Unlike automation or SaaS, which are tools that require human direction, AI Agents can act independently, learn, and evolve, making them a more transformative and compelling advancement in technology. They bridge the gap between human capabilities and machine efficiency, enabling solutions that were previously unimaginable.

The application of AI Agents in procurement and supply chain domains is not just an opportunity but a necessity for large enterprises aiming to thrive in a competitive landscape. B2B commerce is in the process of transitioning to levels of speed and efficiency previously witnessed in E-Commerce. AI Agents for sourcing is a leap forward but also an enabler for further advances. The next step will be multi-agent systems where these agents interact with internal agents such as Inventory Control AI Agents, Demand Forecasting AI Agents etc. We can also expect that they will need to negotiate with Bidding Agents from suppliers so that sourcing in tactical and tail spend will be near instantaneous.

The technology landscape is shifting quickly. AI Agents are still in their early stages but with 71% of sourcing events in Keelvar already agent operated, they are rapidly starting to dominate. The sophistication of these agents is increasing rapidly.

The most important point to note from this white paper is that businesses need to start with a specific use case that is significant enough to warrant the attention of leadership. Once the first success story is shared then the inevitable momentum gathers pace and becomes an unstoppable force.