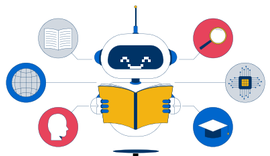
Introducing TechnoCast - Multi Agentic Platform

User : Query

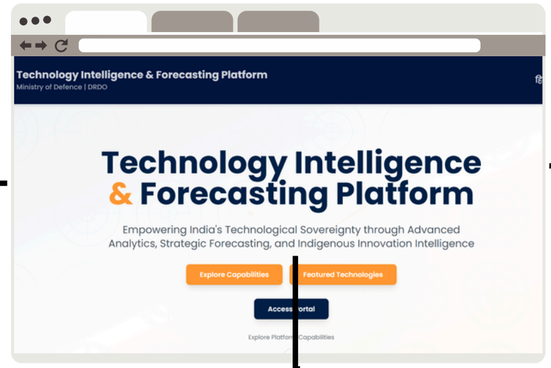
DataBase



Agentic system Gathers all information

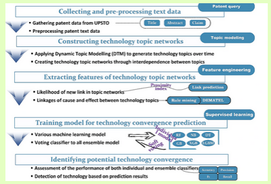
Technological Readiness Level

(Technology Readiness Level (TRL) is a 1-to-9 scale that assesses a technology's maturity from basic research to operational deployment. TechnoCast uses unique research agent information to assess each TRL Level from emergence to lab proven usage. Final synthesis agent classifies the TRL level based on evidence and data received from Research agents.



Technology Convergence

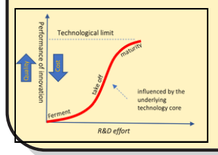
Technology Convergence is the merging of different technologies within a common domain to achieve a shared goal. TechnoCast detects this by using Link Prediction, Dynamic Topic Modelling, and creating Technology Topic Networks. Leveraging critical information from its optimized Research Agent, the platform identifies these converging links to analyze potential threats and benefits arising from the integration of different technology stacks.



Convergence Detection Pipeline

S Curve

A S-Curve depicts technology's emergence, growth and stagnancy in a plot versus time/effort. TechnoCast uses data points from research agents to plot unique S-Curves in Forecasting Dashboard, Example - No. of patents vs Time(depicts emergence), No. of research papers vs time(depicts growth phase).



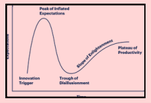
$$N(t) = \frac{M}{1+e^{-(at+b)}}$$

Mathematical function that produces an S-curve is called a logistic.

Gartner Hype Cycle

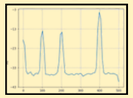
Gartner Hype Cycle formulation plots the hype of a technology based on 5 factors.

- Innovation Trigger: A breakthrough sparks interest.
- Peak of Expectations: Technology is overhyped as a universal fix.
- Trough of Disillusionment: Interest drops as it fails to deliver.
- Slope of Enlightenment: Realistic uses and improvements emerge.
- Plateau of Productivity: Technology becomes useful and mainstream.



Signal Analysis

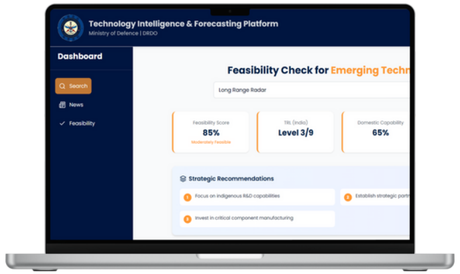
Signal analysis involves interpreting data from Research Papers, patent information and much more to identify weak signals(information not yet recognized). Technocast creates a Knowledge graph from different research agent information capturing weak links with no possible connection forming, using Node and Edge formulation identifying weak edges and strong edges



Market Size

Market size prediction is derived from analyzing industry reports, market trends, and commercialization data from TechnoCast's Research Agents. The system uses these signals to estimate a technology's current and future market potential, thereby assessing its economic viability and scalability for indigenization.

Manual Searching For a Technology	With TechnoCast
• **Weeks to Months.** A team of analysts manually searches databases, reads documents, and compiles findings.	• **Minutes to Hours.** An analyst asks a question and receives a comprehensive, synthesized report almost instantly.
• **Superficial.** Limited to facts found in a few key documents. Trend analysis is a major, time-consuming effort.	• **Deep & Quantitative.** Automatically generates S-Curves, TRLs, Hype Curves, and detects technology convergence.
• **Cost of intelligence is High & Recurring.** Primarily based on the expensive and non-scalable hours of highly skilled human analysts.	• **Cost of Intelligence is Low & Scalable.** High initial investment, but the cost per insight drops dramatically as the system is used.



Prototype Demo Link

Technocast: An AI-Driven Multi-Agent Technology Forecasting Platform

Sarthak Pandey Saarthak Gupta Vasu Mahajan Riddhi Sharma Vaman Soni *
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Abstract—Technology forecasting remains critical for strategic decision-making, yet traditional approaches suffer from fragmentation, manual bottlenecks, and temporal delays that render insights obsolete upon delivery. This paper presents a comprehensive AI-driven multi-agent platform that transforms scattered technology intelligence into real-time strategic insights. Our system integrates patents, research publications, investment data, supplier information, and news streams through a sophisticated pipeline comprising a Clarifying Agent, Research Orchestrator, multi-modal Retrieval Augmented Generation (RAG) with vector databases and knowledge graphs, and specialized Analysis Agents for Technology Readiness Level (TRL) assessment, S-curve modeling, Hype Cycle positioning, market sizing, convergence detection, and weak signal analysis. Unlike manual methods that rely on expert opinion and static bibliometrics, our platform enables continuous monitoring, automated evidence synthesis, and dynamic forecasting at scale. Comparative analysis demonstrates significant improvements in coverage, timeliness, and reproducibility over traditional technology intelligence workflows. The system successfully addresses the fundamental challenge of transforming fragmented multi-source data into actionable strategic intelligence for informed technology adoption and development decisions.

Index Terms—Technology Forecasting, Multi-Agent Systems, Retrieval Augmented Generation, Technology Readiness Level, S-Curve Analysis, Hype Cycle, Patent Analysis, Knowledge Graphs

specialized expertise and cannot maintain comprehensive coverage across rapidly evolving domains [3].

The fundamental challenge lies in information fragmentation. Critical technology intelligence is dispersed across global patent offices (USPTO, EPO, WIPO, IP India), academic databases (IEEE, ACM, Springer), industry reports, financial filings, supplier networks, regulatory announcements, and heterogeneous media sources. Manual synthesis across these sources introduces delays, reduces coverage, and creates reproducibility challenges that undermine strategic decision-making.

This paper addresses these limitations through a comprehensive AI-driven platform that operationalizes technology forecasting as a continuous, automated process. Our contribution encompasses:

- A novel multi-agent architecture that orchestrates specialized LLMs for patent analysis, research synthesis, investment tracking, supplier monitoring, news analysis, and indigenous innovation assessment
- Multi-modal RAG integration combining vector databases for semantic retrieval with knowledge graphs for structured reasoning and evidence traceability

Our own Research Paper Link

TECHNICAL APPROACH

1 Automated Research & Knowledge Expansion

- The Research Agent gathers multi-source data (patents, papers, market, media, financial) to build the Knowledge Graph and Vector DB.
- A Continuous Knowledge Growth Module keeps these expanding with new insights, while multi-modal RAG enables rich contextual retrieval for analysis.

2 Intelligent Query Understanding

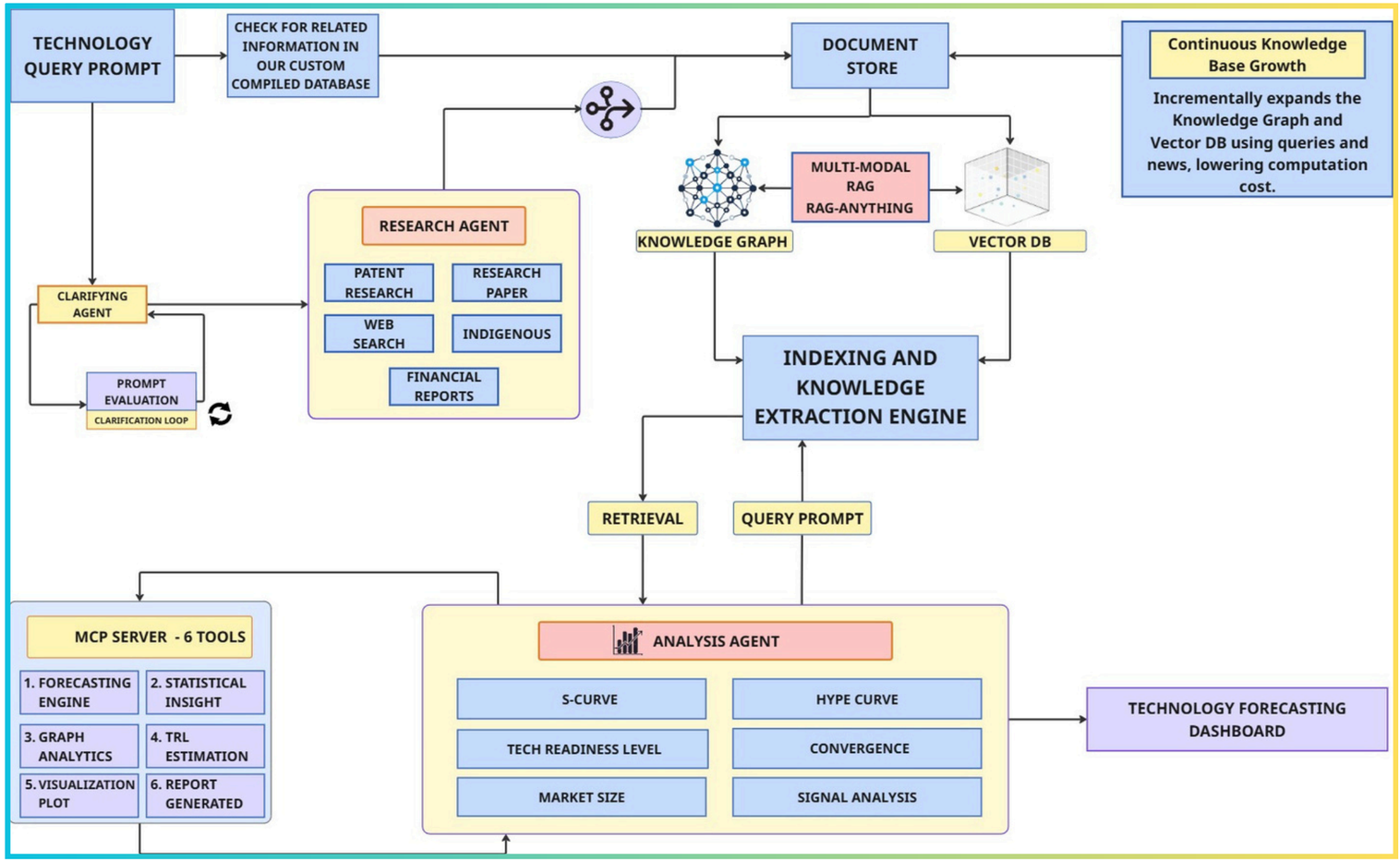
- User queries are refined by a **Clarifying Agent** to capture precise intent.
- The system checks our custom database before launching multi-source research for speed and relevance.

3 Indexing and Semantic Extraction

- The Knowledge Extraction Engine performs semantic indexing, entity linking, and feature tagging to build an interconnected, retrievable data layer.

4 Analytical Intelligence Layer

- The Analysis Agent derives actionable insights
- These analytics quantify technological maturity, adoption rate, and market potential.



5 MCP Server

- A unified MCP Server integrates forecasting, statistical analysis, TRL estimation, visualization, and report generation.

→ The MCP Server centralizes analytical tools as independent, on-demand services to ensure the entire system is scalable, reusable, and easy to update without altering the core agent's logic.

FEASIBILITY AND VIABILITY

Technical Feasibility

- **Proven Component Integration:** The solution is built by architecting existing, state-of-the-art technologies. It leverages proven components like Large Language Models, Retrieval-Augmented Generation (RAG), Vector Databases, and Knowledge Graphs, minimizing fundamental technical risk.
- **Scalable & Modular Architecture**: The system is designed for growth, incorporating intelligent caching to reduce costs, a proactive alerting service for continuous monitoring, and a modular plugin system to allow for future data source integration.

Data Feasibility

- **Accessible Public Data Sources:** The platform's foundation relies on a rich ecosystem of accessible public APIs and open-source databases, including USPTO/IPTO for patents, arXiv for research papers, and SEC EDGAR for financial data.
- **Future-Proof Extensibility:** A core design feature is the ability for DRDO to securely integrate its own internal, classified, or subscribed databases via a simple plugin manager. This ensures the platform remains adaptable to future intelligence needs.

>90% Reduction
in Time-to-Insight for technology forecasting

10+ Public & Private
data source types through the modular framework.

24/7 Automated Monitoring
of user-subscribed technology signals

>50% API Cost Reduction
via Caching and accumulating knowledge base

TECH STACK

- Python
- FastAPI
- PyDantic
- Faiss
- LangChain
- LangGraph
- ReactJS
- Pinecone
- neo4j
- Anthropic MCP
- Kubernetes
- AWS

FUTURE SCOPE

- **Accumulating Knowledge Base:** The platform is designed to store and reuse all retrieved data. This creates a valuable, proprietary knowledge base over time, which reduces reliance on external APIs, decreases costs, and improves response speed, ensuring long-term data viability.
- **Scalable Cloud-Native Architecture:** The platform will be built on a scalable cloud framework with caching and a database indexing to manage computational loads and costs effectively as the system grows.

IMPACT AND BENEFITS

System Impacts & Benifits

- Enhanced Strategic Decision Making
- Accelerated National Self-Reliance
- Massive Operational Efficiency
- Architecture Impact

Architecture Impact

- **MCP Server** allows for task-specific scaling, where computationally intensive tools like "Graph Analytics" can be automatically scaled out across many servers, while lightweight tools like "Report Generation" use minimal resources.
- **Multi-Modal RAG and Knowledge Graph** transforms scattered documents into a single, interconnected network of entities and relationships. Thisallows the Analysis Agents to perform functions like Convergence Detection and Signal Analysis

🎯 Enhanced Strategic Decision-Making

- **Enhanced Accuracy :** By extracting information from data like Patents, Research Papers, etc, forecasting inference becomes highly accurate reducing time & effort significantly.
- **Confidence in Assessments:** Forecasting methods like **S-Curve, Gartner Hype Cycle, TRL's** provide easy inference based on factual and accurate data. This results in high confidence when justifying a project's funding.
- **Proactive vs. Reactive Strategy:** Signal Analysis and Technology Convergence tools **identify nascent threats** and **opportunities.**

Accelerated National Self-Reliance

- **Accelerating 'Aatmanirbhar Bharat' Motive :** The unique **Comparative Hype Cycle Analysis** provides an immediate visual representation of gap between global hype and Indian Market hype
- **Threat Identification:** By using **signal analysis** and **technology convergence** detection, the platform can identify "weak signals" of future disruptive technologies, givingan early start.
- **Future Production Cost and Viability**: The system moves beyond technical feasibility to predict a technology's future unit production cost.

Massive Operational Efficiency

- **Reduces Analysis Time from Months to Days:** TechnoCast, accomplishes in day what currently takes teams of the company would take months to complete, eliminating delays and providing timely intelligence.
- **Empowers Human Capital**: The platform automates the labor-intensive tasks of data collection and processing. This frees up company's pool of specialized experts to focus on high-level strategic analysis, rather than manual data wrangling.
- **Creates a Unified Source of Truth**: It solves the problem of "scattered information" by creating a centralized, continuously updated Knowledge Graph. This ensures all are working from the same comprehensive and current dataset.

RESEARCH AND REFERENCES

Technology forecasting research

[PREDICTIVE MODELING FOR TECHNOLOGY CONVERGENCE: A PATENT DATA-DRIVEN APPROACH THROUGH TECHNOLOGY TOPIC NETWORKS]

[TECHNOLOGY FORECASTING: A CASE STUDY OF COMPUTATIONAL TECHNOLOGIES]

S-Curve Analysis

[THE HYPE CYCLE MODEL: A REVIEW AND FUTURE DIRECTIONS]

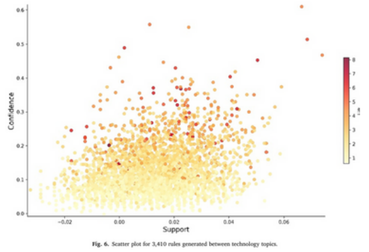


Fig. 6. Scatter plot for 3,410 rules generated between technology topics.

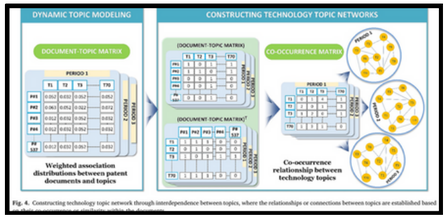


Fig. 4. Constructing technology topic network through interdependence between topics, where the relationships or connections between topics are established based

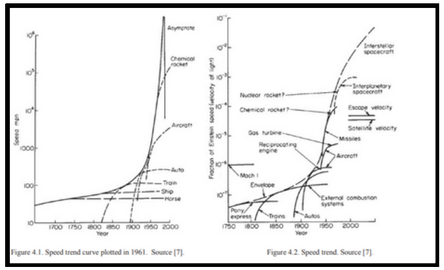
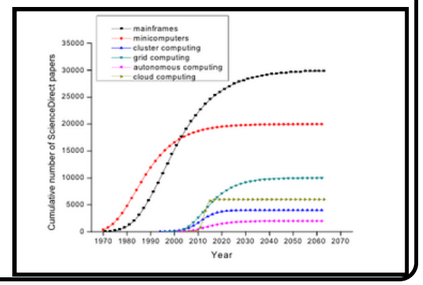
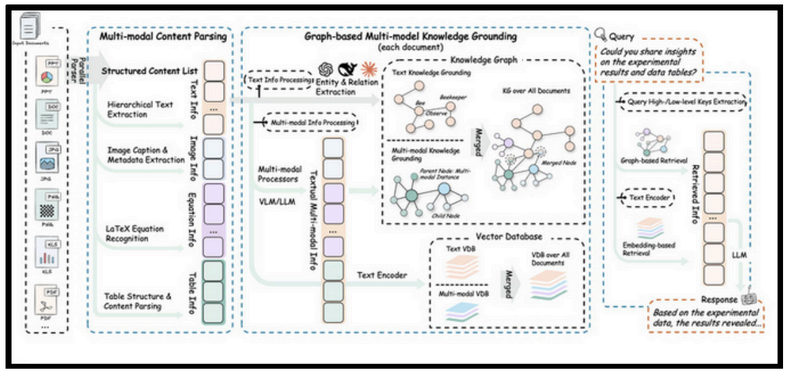


Figure 4.1. Speed trend curve plotted in 1961. Source [7].

Figure 4.2. Speed trend. Source [7].





[RAG-Anything architecture
Multi-modal RAG]

[Model Context Protocol (MCP): Landscape, Security Threats, and Future Research Directions]

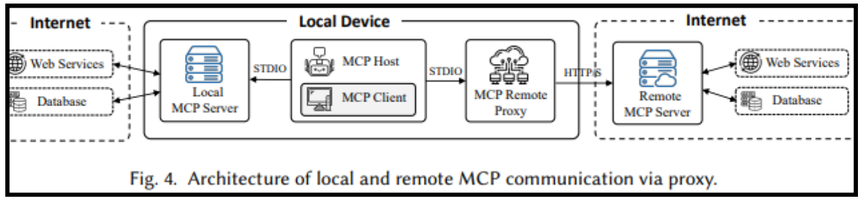


Fig. 4. Architecture of local and remote MCP communication via proxy.

PATENT SEARCH SOURCES

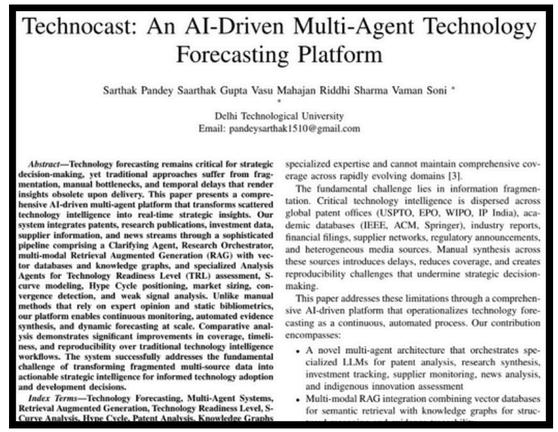
[USPTO]

[Google Patents]

[WIPO PatentScope Search]

[Patent Classifcation Codes (IPC Publication)]

[ESpaceNet (European Patent Office)]



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TechnoCast - Research paper
[Link]

GitHub [Link]

Demo [Link]