

Hype Cycle for Natural Language Technologies, 2021

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Initiatives: [Artificial Intelligence](#)

Recent advances in artificial intelligence and machine learning have enabled innovative approaches and advances in the field of natural language technologies. This report will assist IT leaders in assessing how and where these new opportunities and methods can best be applied.

Analysis

What You Need to Know

Natural language technology (NLT) encompasses the technologies and methods that enable intuitive forms of communication between humans and systems, as well as the analysis of those communications. NLT includes natural language understanding (NLU), natural language generation (NLG), text analytics, dialogue systems, language knowledge graphs, machine translation, text summarization, speech technology and neural symbolic language models.

While language capabilities have existed for several decades, a new generation of capabilities has emerged that uses deep neural network (DNN) machine learning (ML) methods. These new capabilities, combined with existing methods, enable improved functionality.

This report focuses on NLT innovations that incorporate emerging capabilities, often in conjunction with existing methods. IT leaders should understand the technologies outlined in this report in terms of how they can be used to produce useful and differentiating capabilities. Often, the value emerges when the language techniques are combined and integrated with other business applications and processes.

The following two Hype Cycles cover related technologies and trends:

- [Hype Cycle for Artificial Intelligence, 2021](#)
- [Hype Cycle for Data Science and Machine Learning, 2021](#)

The Hype Cycle

This Hype Cycle focuses on language technologies that enable natural, human-like communications. NLT is a subfield of linguistics, computer science and artificial intelligence (AI). In particular, the report focuses on innovations where machine learning deep neural networks are enabling more significant advances in natural language capabilities.

NLT is not a single market or industry, but rather a broad set of capabilities. Functionality is sometimes purchased as a stand-alone capability, or multiple functions are combined to deliver a targeted solution, or functionality may be embedded into existing solutions. The fragmentation in the NLT market is largely due to two factors:

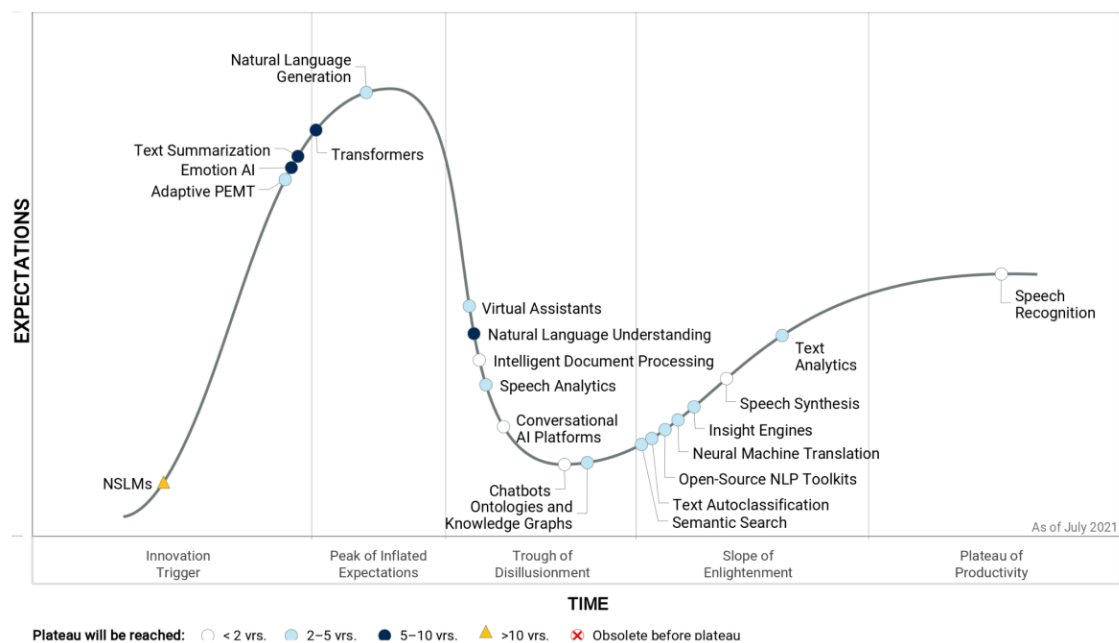
- Many NLTs are broad solution enablers. As a result, functionality may be purchased as a general tool, or it may be embedded into applications targeting specific markets. For instance, text analytics is itself a broad set of capabilities that can be used via APIs. But the functionality may also be embedded within business applications and, in many cases, combined with other language technologies.
- New NLT approaches disrupt existing markets. Many emerging NLT capabilities disrupt solutions that are already established in the market, but are based on an earlier generation of technologies. The emerging solutions may both disrupt preexisting markets and also enable new markets.

IT leaders should focus on finding the most relevant applications of the NLT capabilities outlined in this report. Due to the rapid recent advances enabled by applying DNN methods, care should be taken to separate what is hype and what is actually possible to deliver results. One issue that IT leaders will need to address is the trade-off between selecting NLT solutions from different vendors because they fit a specific need, and selecting a single vendor's NLT solution set. The latter approach will allow for more reuse from the license and the investment in skills.

New entrants this year:

- Intelligent Document Processing
- Neural Symbolic Language Models (NSLMs)
- Transformers

Figure 1: Hype Cycle for Natural Language Technologies, 2021



Gartner

Source: Gartner (July 2021)

Downloadable graphic: Hype Cycle for Natural Language Technologies, 2021

The Priority Matrix

The Priority Matrix maps the benefit rating for each innovation profile (IP) against the amount of time each IP requires to achieve mainstream adoption. The benefit rating provides an indicator of the potential of the IP in general, but the rating may not be applicable to all organizations. As a result, IT leaders should identify which of the IPs offer significant potential benefits to their own organization based on their own use cases. This can then guide investment decisions. IPs offering more significant near-term benefits should be carefully considered, as they can offer both strategic and tactical benefits. Innovations with longer-term benefits should be considered if they offer strategic value.

As the Priority Matrix illustrates, many of the IPs reviewed in this report offer relatively near-term benefits. This reflects the tremendous effect that new AI methods have on NLT methods. Conversational AI platforms represent a particular area of significant exploration and investment among enterprises. Adoption has been assisted by the availability of application development tools. Apart from NMT, the tools in many of the other IPs outlined in this Hype Cycle are not very mature. As a result, IT leaders should consider how to approach solution development when they review these areas.

Table 1: Priority Matrix for Natural Language Technologies, 2021

(Enlarged table in Appendix)

Benefit	Years to Mainstream Adoption			
	Less Than 2 Years	2 - 5 Years	5 - 10 Years	More Than 10 Years
Transformational	Conversational AI Platforms Speech Recognition	Neural Machine Translation Virtual Assistants	Emotion AI Natural Language Understanding Transformers	NSLMs
High	Chatbots Intelligent Document Processing	Insight Engines Natural Language Generation Ontologies and Knowledge Graphs Open-Source NLP Toolkits		
Moderate	Speech Synthesis	Adaptive PEEMT Semantic Search Speech Analytics Text Analytics Text Autoclassification	Text Summarization	
Low				

Source: Gartner (July 2021)

Off the Hype Cycle

- **Natural language processing:** This profile was removed because it generated confusion. NLP encompasses all of the innovations profiled in this report, and so, in many ways, is redundant with the term natural language technology. Relevant elements of the NLP description have been incorporated into this broad report.
- **Large-scale pretrained language models:** This profile was replaced with the Transformer entrant, as that better describes the technology.

On the Rise

NSLMs

Analysis By: Van Baker

Benefit Rating: Transformational

Market Penetration: Less than 1% of target audience

Maturity: Embryonic

Definition

Neural symbolic language models (NSLMs) combine deep neural networks' learning abilities with symbolic models' reasoning abilities to create a new class of language-processing model. NSLMs are designed to transcend the inductive bias of neural network language models (NNLMs) by adding symbolic reasoning that can address the issues that NNLMs face, such as spatial or temporal properties in language that can be represented by logical or mathematical expressions.

Why This Is Important

Deep neural networks have advanced natural-language processing capabilities, but these still have significant limitations. Prior efforts to process language via symbolic models that use symbolic constructs required substantial effort and yielded limited results. NSLMs' combination of the two approaches promises to extend language processing and improve overall results. Although NSLMs are not expected to match human understanding, their combined methodology could advance the state of the art.

Business Impact

- Neural symbolic models could significantly improve the performance of standard language models and facilitate further use of solutions enabled by conversational artificial intelligence (AI).
- Further disruption of language-processing science will result in a volatile, changing vendor landscape for language-processing solutions.
- The investment required to keep up with continually evolving natural language processing technology will put pressure on smaller providers and cause some to exit the market.

Drivers

- Demand for conversational AI technology is growing rapidly, due to the inherent value associated with the technology when it is well-implemented.
- Natural language processing technology has enabled simple implementation of question-and-answer solutions. It is increasingly incorporating transactional capabilities and integrating with automated decisioning and workflow solutions, such as robotic process automation (RPA) tools, and intelligent document processing workflows.
- The introduction of transformer models to the field of language processing has significantly improved the performance of natural language understanding. Furthermore, this technology is still in its early stages and new approaches, such as NSLMs, promise continued dramatic improvement.
- Rapid advances in large language models such as Turing and OpenAI's Generative Pre-trained Transformer 3 (GPT-3) show the potential of language processing to improve rapidly and to generate significant business value across a wide range of use cases.

Obstacles

- Neural symbolic models are a fundamentally different approach to language processing and are at a very early stage of development.
- Combining deep machine learning and symbolic models may prove to be very challenging, and the result may require time to become productive.
- A fragmented natural language technology market will lead to significant confusion and make it harder for enterprises to select the most suitable solution providers for their language-processing needs.
- The incorporation of embedded language-processing solutions into offerings from major enterprise software vendors will complicate the market for conversational AI solutions.
- NSLMs are likely to come from the large cloud providers, which may constrain the innovation within, and the availability of, solutions that use these models.

User Recommendations

- Assume that many natural language solutions will keep evolving rapidly, with the result that they deliver short-term benefits but need to be replaced frequently.

- Expect turnover in the conversational AI vendors to be high and continued volatility in the conversational AI market.
- Invest in language-based solutions tactically, due to the volatile market conditions.
- Plan for continuous improvements in natural language processing technologies. This will fuel deployment of evolving language-processing-based solutions, especially modular or composite solutions that enable swapping of core services (such as the natural language understanding model).
- Don't assume that conversational AI solutions will be limited to simple solutions, as advances in, for example, neural symbolic models and other language technologies are likely to advance language understanding rapidly.
- Plan for a future in which conversational AI is a dominant modality for interaction with enterprise applications.

Sample Vendors

IBM; Microsoft

Adaptive PEMT

Analysis By: Bern Elliot

Benefit Rating: Moderate

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Definition

Adaptive post-edit machine translation (PEMT) solutions allow a human translator to edit a document that has already been machine translated. Typically, this is done sentence-by-sentence using a specialized computer-assisted-translation application. The solutions are considered adaptive because human translator corrections are incorporated into the machine translation model, allowing the accuracy to improve during the editing process.

Why This Is Important

For enterprises requiring significant levels of human translation, adaptive PEMT has the potential to reduce costs. In some cases, it can also speed the translation process. Additionally, as machine translation technology improves, the PEMT process may improve, increasing the effectiveness of adaptive PEMT. However, it is likely that enterprises will find that some specialized translation use cases will still require complete human translation. In those cases, the benefits of PEMT cannot be realized.

Business Impact

Applications that use artificial intelligence (AI) to augment human activity are an effective way to improve task performance. In this case, PEMT augments the task of translation. It transforms the task from writer to reviewer and editor. The edits that a translator makes to the post-edited machine translation (MT) output is used to improve the MT model. This is sometimes called human-in-the-loop (HITL) training. If adaptive PEMT is as effective as early deployments indicate, enterprises may realize significant measurable productivity and operational improvements.

Drivers

- The primary driver for adoption is cost savings. A human translation may cost \$0.08 to \$0.25 per word depending on the skill required. An adaptive PEMT approach is currently estimated to cost \$0.02 to \$0.04 per word. This represents an opportunity for significant savings, even if only 20% of the enterprise documents can be translated with this method. Note that MT-only translation costs approximately \$20 per 1 million characters and so will remain significantly cheaper.
- The adoption of adaptive PEMT may also be facilitated by the adoption of interrelated AI-enabled translation solutions. One of these will allow more effective assignment of translation requests to different translation workflows. One of the workflows would be PEMT. Another solution will allow more transparency around these workflows. This in turn allows more certainty about specific service charges for a given translation job, (for example describing which sections to translate and to what degree). This transparency will also enable better classification of translation tasks. Assignment to different workflows can become more accurate based on feedback on results over time.

Obstacles

- Updating models in real time and allowing the training to immediately influence subsequent MT predictions is new functionality. As a result, the effectiveness of this method needs to be proven.
- The success of adaptive PEMT requires that human translators accept and adopt new technology and methods. Human translators may perceive this as a threat to their job security and value.
- Most enterprises will most likely still require a combination of translation approaches, even if they use adaptive PEMT.
- Organizational inertia often inhibits adoption of new methods. This may result in lagging adoption by enterprises.

User Recommendations

- Use an adaptive PEMT approach if your organization is supporting initiatives that require a high volume of translations. This can help you achieve significant savings.
- Use change management programs when introducing the solution. Some human translators may perceive this method as a threat. These programs will assist in making the transition.
- Users should anticipate the need to use early adopter methods. Products in this sector are new. Market leaders and best practices have not yet emerged.

Gartner Recommended Reading

[Machine Translation Improvements Justify Re-examining Your Options](#)

[Market Guide for AI-Enabled Translation Services](#)

Emotion AI

Analysis By: Annette Zimmermann

Benefit Rating: Transformational

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Definition

Emotion artificial intelligence (AI) technologies (also called affective computing) use AI techniques to analyze the emotional state of a user (via computer vision, audio/voice input, sensors and/or software logic). It can initiate responses by performing specific, personalized actions to fit the mood of the customer.

Why This Is Important

Emotion AI is considered transformational as it turns human behavioral attributes into data that will have a large impact on human-machine interface (HMI). Machines will become more “humanized” as they can detect sentiments in many different contexts. Furthermore, applying deep learning to computer vision or audio-based systems to analyze emotions in real time has spawned new use cases for customer experience enhancements, employee wellness and many other areas.

Business Impact

- Contact centers using voice analysis and natural language processing (NLP)-based algorithms to detect emotions in voice conversations, in personal chat conversations, even chatbots and call routing.
- Computer vision (CV)-based emotion AI has already been used for more than a decade in market research with neuromarketing platforms that test users’ reactions toward products and services.

In addition, we see the technology expanding to other verticals, such as medical research, healthcare (diagnostic) and retail (customer experience).

Drivers

We have moved this Hype Cycle entry two positions along (approaching the Peak of Inflated Expectations) due to vendors supporting more use cases that deliver business value. The increasing number of use cases we have identified indicates an increase in commercialization as emotion AI finds applicability in new domains.

- One of the drivers for detecting emotions/states is the need for a system to act more sympathetically. For instance, it creates anthropomorphic qualities for personal assistant robots (PARs), making them appear more “human.” This “emotional capability” is an important element in enhancing the communication and interaction between users and a PAR. This can be an empathic avatar or an emotion-detection-enabled chatbot. A person’s daily behavior, communication and decisions are based on emotions — our nonverbal responses in a one-to-one communication are an inseparable element from our dialogues and need to be considered in the human-machine interface (HMI) concept.
- Strongest adoption is currently happening in the context of contact centers where voice-based emotion analysis supports multiple use cases such as real-time analysis on voice conversations, emotion detection in chat conversations, emotional chatbots and more.
- Market research and neuromarketing tools are continuously leveraging emotion detection in various user scenarios including focus groups and product testing. Vendors have been extending their offerings toward remote/online interviews during 2020 — due to the pandemic.
- Employee stress monitoring and employee wellness have received more attention in 2020 and we expect this to become a prominent trend in the near-term.

Obstacles

Some of the main hurdles we have identified:

- Privacy concerns are the main obstacle to rapid adoption in the enterprise. Not in all use cases and scenarios does it play a role, but mainly in public venues or a virtual training setting, users may not want emotions to be detected and analyzed.
- Data quality (lab-based versus real-life data) and machine learning (ML) techniques determine the reliability of the technology to detect emotions. The better the data and the more data there is, the higher the probability of detecting different nuances of human emotions. When using facial expression analysis, models are likely to be retrained in different geographies to get the system to detect the different nuances present due to different cultures.
- Certain emotions can be better detected with one technology mode than with another. For instance, “irony” can be detected using voice-based analysis while this is very difficult to detect with facial expression analysis.

User Recommendations

As the market is currently very immature, most vendors are focused on two or three use cases in two or three industries. At the same time, identifying and processing human emotion is currently a gray area, especially in the EU. The EU Commission has started an initiative to review the ethical aspects of AI technologies, and emotion AI will certainly be part of this debate. Hence, when selecting a vendor, it is important to review their capabilities and reference cases.

- Be use-case-driven. The use case will determine the emotion AI technology to be used and vendor selection.
- Appoint responsibility for data privacy in your organization — a chief data privacy officer or equivalent.
- Work with your vendor on change management in order to avoid user backlash due to sensitive data being collected.

Sample Vendors

Affectiva; audEERING; Behavioral Signals; Cogito; DAVI; Google; Intelligent Voice; Soul Machines; Superceed; Uniphore

Gartner Recommended Reading

[Competitive Landscape: Emotion AI Technologies, Worldwide](#)

[Cool Vendors in Conversational AI Platforms](#)

[Emerging Technologies: Emotion AI in the Workplace](#)

[Competitive Landscape: Customer Analytics](#)

Text Summarization

Analysis By: Shubhangi Vashisth, Stephen Emmott

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Definition

Text summarization is a range of techniques that automatically produce short textual summaries representing longer or multiple texts. The principal purpose of this technology is to reduce human time and effort required to acquire insight from content, either by signaling the value of reading the source(s) or by delivering value directly in the form of the summary.

Why This Is Important

The principal beneficiary of text summarization is human rather than machine. Appropriate use of the technology can reduce task time and effort, improving access to insight for all employees of an organization, reducing the orientation required for decisions and actions, and stimulating ideation.

Business Impact

Text summarization is increasingly valuable across many use cases:

- The principal use of this technology is and will continue to be in real-time, reader-led, summarization of found/shared documents.
- Across all vertical industries, the functional domains that are likely to benefit most from text summarization are legal, finance, HR and supply chain. Other sectors such as education and government could also benefit from the technology.

Drivers

Technology to summarize text dates back to the 1950s. Key drivers include:

- Reduce employee time and effort required to acquire insight from content.
- Recent advances in AI-herald-abstraction-based approach as a viable way to apply text summarization at the domain and foundation, as well as situation levels of the application portfolio.

The approaches taken for text summarization are below. Among the two options, extraction remains the dominant form:

- **Extraction** — This is where statistically significant words, phrases and sentences are extracted, leaving the rest. It is comparable to, but falls short of, skim reading the source.

- **Abstraction** — This is where supervised learning is used to map salient words and phrases from the source into novel sentences in the target.

Obstacles

Though the technology continues to improve in performance, it falls short of being able to present summaries in a way that is of greater benefit to employees than to the source.

This stems from the approaches taken and their inherent limitations:

- **Quality** — The extraction approach is well-established but produces summaries that are further removed from the quality of human-generated summaries.
- **Contextualization** — The abstraction approach has emerged in recent years and produces summaries that are closer to human-generated summaries, but requires training in context and is therefore more challenging and costly to apply.
- **Omission of key information** — Missing vital information from a summary reduces the quality of insight needed from the source document, which can adversely impact analysis, decision and action. Such risks are intolerable in many vertical industries and functional domains, such as compliance within banking or research within life sciences and healthcare products.

User Recommendations

- List the business functions and use cases that require text summarization capabilities and check if these capabilities are embedded within existing applications. Text summarization is often deployed as a component part of the applications that are specific to, or customized for, these situational uses.
- Explore the use of open-source capabilities for text summarization.
- With an abstraction-based approach, application leaders should approach the technology as a prepackaged business capability (PBC) that can be reused across the application portfolio.

Sample Vendors

Amazon Web Services; Datamatics; Google; iManage; IBM; Lexalytics; Microsoft

Gartner Recommended Reading

[Cool Vendors in Natural Language Technology](#)

[Market Guide for Text Analytics](#)

[Understanding Your Customers by Using Text Analytics and Natural Language Processing](#)

[How to Benefit From Creative AI — Assisted and Generative Content Creation](#)

At the Peak

Transformers

Analysis By: Martin Reynolds

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Adolescent

Definition

Transformer-based language models are a type of deep neural network architecture that evaluates words as sequences in a sentence. This sequence-based approach significantly improves transcription accuracy, improves processing across languages and can synthesize complex well-constructed sentences. These models can be tuned to different text domains with minimal customization. Transformers are also finding use in domains such as imaging and biochemistry.

Why This Is Important

Transformers deliver a significant improvement in text prediction accuracy. These predictions, for example, can deliver superior translations between languages, create large, well-formed sections of text from a few key phrases, create music, or identify hidden relationships across bodies of text. Transformer solutions result in many successful AI deployments and are extending into images and biochemistry.

Business Impact

Transformers deliver material improvement in text processing, sufficient that many language-based applications advanced from potentially useful to generally effective. This advance is further supported by relatively simple techniques that adapt transformers to different text domains, be it languages or specialist fields such as biochemistry or law.

Transformers deliver superior speech classifications for automated voice response systems, improving overall response accuracy.

Drivers

- **Transformers require only limited model customization to deliver effective results.** Clients report to us that they are able to use Google's open-source BERT implementation without training the entire network. Rather, they retrain only the top few layers to customize for their language domain.
- **Transformers deliver superior text classifications.** The difference between transformer-based models and prior DNN solutions is stark. Transformers model patterns in relatively large blocks of text, as opposed to predicting the next word based on the preceding snippet. These improvements have materially advanced speech and text applications. A notable example is the improvement in Google Translate.
- **Transformers can create well-formed text passages from minimal inputs.** A variant on transformer models is GPT-3, developed by OpenAI and licensed by Microsoft. This transformer model, which incorporates 175 billion parameters, is designed to create paragraphs or pages of text from small snippets. GPT-3 does this based on predicting the most likely next word in a sentence, based on its absorbed accumulated training.

Obstacles

- **Transformers do not deliver perfect results.** Although a significant advance, transformers still require careful training, and can deliver unacceptable results. GPT-3 delivers near-perfect prose, but the output may also be perfectly inaccurate. As with all AI systems, constraints are important to keep the program aligned with business needs.
- **Transformer configuration requires appropriate skills and talent.** As with all AI solutions, the end result is dependent on the skills, knowledge and talent of the trainers. Although transformers appear to be somewhat easier to configure than other systems, better training will deliver better results.
- **Newer transformer models are expanding to impractical sizes.** Large models are up to a trillion parameters, with relatively small improvements. These models are impractically large to train for most organizations because of the necessary compute resources, and their large scale drives relatively heavy inferencing workloads.

User Recommendations

- **Immediately slipstream transformers into existing speech or text programs.** If you have any older language processing systems, deployed or in development, moving to a transformer-based model could significantly improve performance. One example might be a voice interface, where transformers can interpret multiple ideas in a single utterance (e.g., “I want a pizza with thick crust, extra cheese and sausage,” as opposed to selecting each item from a voice-based menu). This shift in approach can significantly advance language interfaces by reducing the number of interactions.
- **Start with Google’s BERT open-source model.** Although GPT-3, Microsoft DeepSpeed and Google Switch Transformers promise superior results, the extra complexity may not justify advancing from BERT. BERT is supported by many DSML platforms.
- **Leverage existing trained transformer networks as the base of language projects.** Many BERT models are available as open source. A good place to find these models is this [list](#).

Sample Vendors

Amazon; Google; Microsoft; OpenAI

Natural Language Generation

Analysis By: Bern Elliot

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Definition

Natural language generation (NLG) solutions automatically convert structured data and, in some cases, unstructured data — such as that found in a database, an application or a live feed, or images — into a text-based narrative. This makes the data easier for users to access by reading or listening, and therefore to comprehend.

Why This Is Important

NLG solutions can improve operational efficiency, making it easier to appraise, via summary, large or complex material and data, enabling new options for business process automation. Most solutions currently in the market are based on an older “slot-filling” methodology. But emerging solutions are evaluating how to leverage transformer artificial intelligence (AI) techniques to generate natural novel narratives, as well as other AI techniques to enable more complex use cases and increased automation.

Business Impact

NLG supports a number of productivity-enhancing use cases that can reduce the need for writers. It can clarify complex information such as analytic reports, can increase the speed at which textual information can be produced and shared, and can allow applications to communicate with users and audiences in a more fluid and natural manner. The emerging translator solutions hold the promise of expanding the scope and quality of what can be generated, and the breadth and complexity of the use cases that could be supported.

Drivers

The most common uses cases for NLG driving adoption fall into several categories:

- **Enhance understanding of business analytics.** For instance, integrating NLG functionality with existing analytics and business intelligence (BI) and data science initiatives.
- **Article-type short summaries.** For instance, writing summaries or analysis of business data, financial data, wealth management information, or sports.
- **Conversation responses.** For instance, writing personalized communications to customers via email or text.
- **Easing data access.** For instance, writing short, prose-base product descriptions based on database product information. These might then be posted as a reply to website information requests.
- **Generating variants of outbound messaging and marketing copy.** The last four years have seen growth in the number of short-form NLG specialist vendors.

Emerging, more complex, use cases include:

- The combination of NLG with automated pattern/insight detection and self-service data preparation. This can drive the user experience of next-generation augmented analytics platforms. Users have varying degrees of analytics skill to correctly interpret and act on statistically significant relationships in visualization. This use case could also expand the benefits of advanced analytics to a wider audience of business users, as well as making existing analysts and data scientists more efficient.
- Context-based narration will reinforce mobile BI use cases, where a lack of screen space is a major impediment to information consumption. It will also expand the use of conversational analytics that combine natural language query (NLQ), chatbots and NLG via virtual personal assistants.
- Conversational solutions, including virtual assistants, will be able to use NLG methods to enable more complex and natural-sounding interactions.

Obstacles

NLG solutions based on slot-filling are mature. However, major barriers exist for more sophisticated solutions that leverage advanced AI techniques:

- **Complexity barrier.** Advanced AI techniques, such as transformer-based language generation and case-based learning, are complex applications to build. The optimal algorithms and parameter settings must be explored. Often, these have significant compute and memory requirements, which add to cost and challenges.
- **Cost to scale.** Additionally, scaling these applications for production may require optimization and possibly specialized hardware to contain costs.
- **Advanced application development tools.** In order to properly leverage the newer AI techniques, NLG solutions will need to offer tools that enable users to customize the solution to their specific domains and use cases. As a result, much more-advanced and, critically, more user-friendly, tools will be needed.

User Recommendations

- **Be aware of a solution's maturity**, particularly in terms of data integration and preparation requirements, the platform's self-learning capabilities, upfront set-up and configuration required, the range of languages supported, the extent of narration for a single chart or across a dashboard, the degree of story automation and control supported, and the accuracy of the findings and narration.
- **Understand potential drawbacks** relating to multilingual user scenarios, as NLG requires specific libraries for each language in use. Additionally, industry-specific use cases need to be considered carefully with respect to jargon, tone and specialized ontologies.
- **Recognize that NLG could be attractive to organizations** that are wishing to have their analytics, BI solutions and other classes of visual information accessible to those audiences that are visually impaired; for instance, to comply with the Americans with Disabilities Act (in the U.S.) and similar mandates in other countries.

Sample Vendors

ARRIA NLG; Automated Insights; AX Semantics; Marlabs; Narrative Science; Salesforce; Sasa Software; ThoughtSpot; Yseop

Gartner Recommended Reading

[2021 Strategic Roadmap for Enterprise AI: Natural Language Architecture](#)

[Magic Quadrant for Analytics and Business Intelligence Platforms](#)

Sliding into the Trough

Virtual Assistants

Analysis By: Van Baker

Benefit Rating: Transformational

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Definition

Virtual assistants (VAs) help users with tasks previously handled by humans. VAs use semantic and deep learning models, natural language processing, prediction models, recommendations and personalization to interact with people via voice or text conversations. Increasingly, they also automate processes and workflows. VAs learn from user behaviors, build data models, and recommend and complete actions to support VA users. VAs can be deployed in simple as well as complex use cases.

Why This Is Important

Conversational interactions are inherently appealing to both customers and members of the workforce. The ability to converse with applications to retrieve information or accomplish transactions is a natural extension of human-to-human interactions to human-to-machine interactions. A well implemented virtual assistant is always available, cannot be distracted, and can be very efficient in assisting humans in accomplishing tasks and retrieving necessary information.

Business Impact

VAs, RPA, event brokers and other technologies are automating the enterprise. VAs use contextual multiturn conversations to drive business workflows. Integration with enterprise applications enhances the handling of complex tasks by VAs. Consumer VAs led to enterprise VAs embedded in SaaS platforms. Business channels such as websites, mobile apps and messaging are commonplace. Voice-based VAs are becoming the focus of conversational AI providers. Additionally, use of VAs can expand hours of operation and improve customer response time.

Drivers

- Customer expectation for access to customer service anytime, anywhere. This is especially true for online e-commerce businesses that have seen extreme growth in response to the pandemic.
- Consumer expectation for access to product information anytime, anywhere. E-commerce is a 24/7 business and consumers expect to get their answers whenever they engage.
- Employee access to information on a real-time basis via conversational queries, resulting in enhanced productivity because of increased use of business-critical information.
- Increasing demand for technology that is easy to understand and interact with. While this is true for all workers, it is especially needed by remote workers in the enterprise.
- A strong desire by businesses to automate business workflows and processes wherever automation can deliver value to the business.
- The ability to initiate communication with your workforce in response to event triggered conditions or transactions. This facilitates more timely response to changing business conditions by removing the need for workers to initiate transactions.
- The ability of conversational AI platforms to deliver more complex transaction capabilities spanning multiple users and business processes.
- Improved access to the business across multiple channels addressing the preferences of particular customer segments, allowing them to select their channel and modality of choice.
- Improving capability for conversational AI platforms to use natural language generation. This allows the virtual assistants to initiate interaction with customers and employees rather than just reacting to user requests.
- VA tools are becoming available that enable the automatic ingestion of unstructured and structured data to enhance and improve the language models.
- Enabling technologies are making creation of VAs easier such as low-code tools, automated identification of intents and entities, and the use of APIs for complex integrations.

Obstacles

- Poor or inadequate language models for the use case that is deployed. The virtual assistants need to be able to respond to an extraordinary variety of users' questions. They should also be able to handle off-topic questions to some degree.
- Inadequate conversational AI platforms that do not have the capabilities needed to deliver virtual assistants. Many platforms lack the ability to handle complex transactions, context switching, multi-intent utterances, strong integration, process automation and other functionality needed for virtual assistance level capabilities.
- A design approach that oversimplifies use cases for virtual assistants. Many dialogue designs assume consistency in the way that people ask questions or do transactions that do not exist. This often leads to successful pilot development efforts that fail upon deployment.
- The need for ongoing continual retraining of the language models is often overlooked or ignored leading to poor performance over time.

User Recommendations

- Assess the continual rapid evolution of the technologies that support the creation and deployment of virtual assistants. These technologies are evolving at a very rapid pace that is not expected to slow in the near term.
- Deliver significant levels of integration and business process automation in conjunction with virtual assistant conversational capability as the platforms in the market are becoming increasingly sophisticated. Many conversation AI platforms include workflow automation capabilities as part of their offering.
- Evaluate that VAs will have voice and text capabilities with voice becoming the dominant modality.
- Define a chatbot strategy at the enterprise level and decouple the technical decisions from it.
- Pick your core services by favoring modular technical solutions that allow the same.

Gartner Recommended Reading

[When Should I Use Embedded Conversational Assistants?](#)

[Making Sense of the Chatbot and Conversational AI Platform Market](#)

[Craft a Chatbot Initiative Based on Your Business Requirements and Solution Complexity](#)

Roles and Responsibilities for Scaling Chatbot Initiatives

Solution Criteria for Enterprise Conversational AI Platforms

Natural Language Understanding

Analysis By: Bern Elliot

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Definition

Natural language understanding (NLU) is a subtopic of the natural language processing (NLP) field of AI. NLU focuses primarily on interpretation or understanding the text and is typically based on matching the parsed input to an underlying knowledge model or structured ontology.

Why This Is Important

NLU encompasses a broad range of applications, from simple understanding tasks such as interpreting short direct commands, to complex understanding tasks such as comprehending newspaper articles or maintaining a humanlike conversation. NLU functionality, even the basic ones, offers enterprises useful ways of directing the actions of a business application, appliance or device.

Business Impact

There is significant and widespread demand for systems that can understand or interpret natural language and that can interact with people in a conversational style. Applications that leverage NLUs include chatbots, virtual assistants, text summarization, and text content analysis. Other uses include vehicles, machinery and consumer “intelligent” devices. In many cases, the effectiveness of the NLU will determine the overall satisfaction with the application or appliance.

Drivers

The fundamental driver for NLU improvements is a more accurate identification of a user's intent. NLP looks at what was said or written, while NLU looks at what was meant. People have multiple ways of expressing the same thing. Conversely, people may use the same words to express different meanings. The NLU functionality will examine the parsed elements of the text and allow an application to interpret what was meant or intended based on its underlying model.

NLU plays a significant role in key functions and applications, including:

- **Chatbots and virtual assistants:** NLU enables the chatbot to identify the intent of the user's input. And as needed to extract key entities from that. For instance in the request "I'd like to order a large, mushroom, pizza." Ordering pizza is the intent, and mushroom and large are entities needed to properly complete the order.
- **Text categorization and classification:** NLU enables systems to analyze and assign text input into predefined categories. Examples include spam filters and script compliance.
- **Automatic text summarization:** NLU can play a role in creating summaries of longer text sections.
- **Question answering and semantic parsing:** QA systems leverage several of the above outlined functions to create a natural language interaction.
- **Sentiment analysis:** NLU helps to identify and measure the sentiment behind an opinion or context.

Obstacles

- **Complexity:** While some NLU objectives are simple, many are complex, which become an obstacle to successful usage. Factors driving complexity include the use of large-scale vocabularies, grammars, ontologies and models. Significant progress is needed on each of these factors before complex applications of NLU are ready for mainstream adoption.
- **Customization:** Many NLU implementations require customization in terms of the factors mentioned above, as well as custom training datasets.
- **Evolving technology:** The optimal techniques for implementing NLU continue to evolve. While methods such as tree graph analysis are well-established, newer methods based on transformer algorithms are just starting to emerge.
- **Bundling:** NLUs are often bundled within a chatbot platform and are managed via an integrated developer environment. As a result, they are often not separately reviewed.

User Recommendations

- Examine the architecture of the NLU module. Each NLU solution is intimately tied to its NLP environment as well as the application it supports, the model(s) it supports, and the data that is in the model. It is critical that enterprise technical teams understand how these interrelated areas come together with the NLU module.
- Determine the types of NLU modules that best fit your models. In some cases, it may be useful to have NLU modules that can be interchanged, that support multiple underlying models, or that offer preexisting data for the models.
- Evaluate the NLU options based on the specific types of language and the types of use cases that enterprise technical teams will need to support.

Sample Vendors

Amazon Web Services; IBM; NLTK Project; Rasa

Gartner Recommended Reading

[Architecture of Conversational Platforms](#)

[Craft a Chatbot Initiative Based on Your Business Requirements and Solution Complexity](#)

[2021 Strategic Roadmap for Enterprise AI: Natural Language Architecture](#)

Intelligent Document Processing

Analysis By: Shubhangi Vashisth, Stephen Emmott, Anthony Mullen

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Adolescent

Definition

Intelligent document processing (IDP) uses natural language technologies and computer vision to extract data from semi structured and unstructured content, especially document-based content, to support automation and augmentation. IDP solutions extract data for analysis and insight, and support automation of high-volume, repetitive document processing tasks.

Why This Is Important

Intelligent document processing is increasingly important to create operational efficiencies in business processes that need to extract information from semistructured and unstructured data for further analysis. These processes currently are majorly human centric. IDP caters to a wide variety of use cases — from digitization initiatives to supporting more complex processes such as document-centric taxation processing and pension fund management.

Business Impact

- Reducing human labor to process documents and the improvement of document-based workflows.
- Extracting relevant data from different input formats for further analysis or automation.
- Preprocessing unstructured data for analysis.
- Automated document and email classification and consolidation.
- Discovery and insight.
- Creating workflows to support process automation or integrate with existing automation solutions.
- Leveraging human-in-the-loop (HITL) to continuously improve automation accuracy.

Drivers

Key drivers include:

- Consolidating document processing across multiple applications into one component.
- The need to ingest data from a wide variety of sources and in different formats (e.g., pdfs, images) and extract information from the same.
- Achieve high accuracy and efficiency in the extraction and automation processes for operational efficiencies.
- Enhanced capabilities to denoise and preprocess data.
- Support for additional capabilities such as document classification, metadata extraction, knowledge graphs, search, natural language query and answer.
- Increased leveraging of HITL training methods to simplify adoption and deployment.

Examples of use cases span many enterprise departments and vertical industries, including:

- Accounts payable/receivable: Processing of invoices, payments, expense reports and receipts.
- Healthcare: Processing of medical forms.
- Banking and financial services: Processing of loan applications, drivers licenses and other collateral; customer onboarding; ESG; and compliance.
- Government: Processing of forms, drivers licenses, passports and other IDs.
- Manufacturing: Processing of equipment maintenance records, RFPs, business contracts and operating agreements.
- HR: Employee onboarding, travel and expenses.

Obstacles

- The technology is tied to domains (industry plus function plus scenario), so it is challenging to apply outside those the vendor is practiced in.
- The market has a competitive vendor landscape with dedicated solutions and offerings from OCR and RPA vendors, cloud providers, and, increasingly, service providers. Selecting the right solution gets tricky, as vendors offer overlapping capabilities and differentiation is low.
- Many organizations already have either a homegrown solution or an existing IDP tool but are looking for enhanced features to cater to wider use cases and growing business needs. However, integration complexity makes it challenging.
- Category bleed confuses buyers. With semantic platforms, insight engines, RPA and conversational AI vendors all offering IDP-like solutions to interpret and mine document form factors, buyers may not feel compelled to purchase an additional format-specific (document) solution.

User Recommendations

- Evaluate the entire business process to understand where and how IDP solutions can be integrated. Treat IDP as a component that integrates with other platforms/applications.
- Adopt industry- and or business-domain- focused solutions for a quick time to start.
- Align with stakeholders on accuracy and efficiency baselines for the process.
- Investigate the difference between placed-framed extraction and semantic-framed extraction – the former is not IDP, and only the latter can scale to unstructured content.
- Design the HITL validation process either by leveraging internal sources or through outsourcing the same to the IDP solution provider.
- Discuss specialized requirements such as ability to process documents in entirely new formats, data preprocessing needs and SLAs around processing time.
- Compare the ease of integration of new tools if looking to complement capabilities of an existing solution.

Sample Vendors

Alkymi; Altilia; Amazon Web Services; Applica; Datamatics; DocDigitizer; Eigen Technologies; Google; IBM; Indico; Infrd; Microsoft

Gartner Recommended Reading

[Market Guide for Text Analytics](#)

[2021 Strategic Roadmap for Enterprise AI: Natural Language Architecture](#)

Speech Analytics

Analysis By: Steve Blood

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Definition

Speech analytics is a combination of phrase-matching, phonetic indexing and transcription technologies used to extract contextual insights from recorded and real-time voice streams. Speech analytics surface insights such as topics, categories and emotional engagement in conversations. Artificial intelligence and machine learning improve categorization and accuracy of analysis. Use cases range from customer service to workplace analytics and compliance across multiple industry verticals.

Why This Is Important

Rapid advancements in speech-to-text technologies and natural language technology in recent years, including the use of AI techniques, such as machine learning, have improved categorization and analysis accuracy. This is enabling organizations to be more confident about using insights surfaced from analyzing voice conversations for compliance, training and collaboration initiatives.

Business Impact

Speech analytics can be used to provide insights into:

- Employee performance and compliance by analyzing conversations for keywords, acoustics and talk over to highlight areas where further training could be required.

- The content of internal meetings and work sessions to identify subject matter experts and manage compliance.
- Emotional analysis to provide feedback on customer and employee sentiment, individually or in aggregate.
- Insights on conversational dynamics, topics and flows.

Drivers

- A common use case for speech analytics is found in the customer services department. These use cases focus on mining of recorded calls to surface insights into quality of customer interactions, customer satisfaction and sentiment, opportunities for employee training as well as real-time analysis for compliance and next best action.
- Just as sentiment analysis is used in determining customer satisfaction in the front office, it could also be used to determine employee sentiment as part of a broader voice of the employee initiative. Analysis of conversations in the enterprise will greatly increase the ability to monitor compliance and risk, identify areas of improvements and streamline automation of processes.
- There is an emerging set of use cases for speech analytics in the digital workplace for meetings and content management platforms. Transcription is already available with providers such as GoToMeeting, Cisco, Microsoft (Teams and Azure), Zoom and Amazon Web Services (AWS) Media Services.
- Analysis of the conversational track to surface insights from collaboration (such as Cisco's Voicea acquisition) is an important step in understanding and cataloguing the content. The opportunity to use real-time speech analytics to support meetings with real-time content and actions is the next possible step for speech analytics in the digital workplace (see [Predicts 2021: Artificial Intelligence and Its Impact on People and Society](#)).

Obstacles

- Speech analytics is fragmented across multiple operations in organizations, with little coordination for selecting a primary vendor to meet multiple business use cases. This will hamper broader scale and adoption of speech analytics as they remain discrete projects.
- Speech-to-text capabilities are progressing rapidly but understanding intent and surfacing useful insights from analysis require investment in people and time. A continual update of company-specific data is essential to uncover useful insights across the organization.
- Monitoring and analysis of conversations in the enterprise can have a positive impact on operational performance. But if not used positively, the perception of “big brother” listening to and analyzing what people say can lead to disengagement of associates and distrust of employers.

User Recommendations

- Conduct pilot projects to evaluate whether speech analytics can provide demonstrably valuable insights into customer sentiment, employee quality as well as operational excellence. Align speech analytics with other customer service analytics initiatives, such as text analytics, which is inherently more mature.
- Experiment with meeting transcription and analytics to tease out the value of surfacing insights from a series of internal meetings.
- Favor the SaaS deployment model with short-term licensing commitments or consumption-based billing to limit financial exposure as part of a trial. Ensure your data privacy and security requirements are maintained through trial into production.
- Create policies and an ethics board with employee representation for fair use of conversational data.
- Engage HR councils and workers representatives to ensure the thin line of monitoring and analysis is not overstepped. Look for positive use-case examples of analytics already in use in the organization.

Sample Vendors

Amazon Connect; Cisco (Voicea); Google Cloud Platform; IBM Watson; Intelligent Voice; Microsoft Azure; Uniphore; Zoi Meet

Gartner Recommended Reading

[Predicts 2021: Artificial Intelligence and Its Impact on People and Society](#)

[How to Harness Voice of the Employee Insights for Continuous Employee Experience Improvement](#)

[How to Use AI to Improve the Customer Experience](#)

[Use Speech Analytics to Optimize Contact Center Costs With Self-Service, Process Improvement and Deeper Engagement](#)

[Infographic: Artificial Intelligence Use-Case Prism for Customer Service](#)

Conversational AI Platforms

Analysis By: Magnus Revang

Benefit Rating: Transformational

Market Penetration: More than 50% of target audience

Maturity: Early mainstream

Definition

Conversational AI platforms can be used by developers to build conversational user interfaces, chatbots and virtual assistants for a variety of use cases. They offer ways to determine intent and entities from natural language, tie those to dialogue management, and enable integration to chat platforms and back-end systems.

Why This Is Important

Chatbots, virtual agents and other conversational user interfaces are becoming the face of AI. Enterprises are adopting this technology for a variety of use cases, spanning customer service, IT service desk and human resources, for tasks like recruitment, debt collection, appointment booking and more. Conversational AI Pplatforms are the underlying collection of technologies that enables this.

Business Impact

Automating interactions in the enterprise has tremendous business impact that cannot be understated. The cost and number of employees in customer call centers, IT service desk and HR operations present a compelling business case. Mature organizations are looking even further, to using this technology for proactive conversations that would not have been possible with a strong reliance on human labor.

Drivers

- Demand for conversational AI platforms has increased during the pandemic period as enterprises have looked to keep their customer service running with less labor available. For some industries that have seen a spike in demand due to changing customer behavior, it's been a necessity to be able to deal with the increased volume.
- The number of vendors is still at a staggering 2,000-plus worldwide. Although Gartner estimates that only about 150 of these vendors can be considered to be possible strategic choices for the major use cases.
- While there is still value in specialist offerings — vendors that specialize in industry, domain or even tasks — long term the market will be dominated by larger horizontal platforms that offer industry, domain and task components on top of a versatile platform core.

Obstacles

- The majority of buyers today remain immature. Most have little experience and rely on outdated advice and practices.
- Vendors and customers alike are frustrated by the number of offerings, the diversity of deployment approaches, the different pricing models, unclear scopes of work, and the inability to measure the quality of a platform and implementations. This creates a rationale for the category being squarely in the Trough of Disillusionment. However, Gartner expects the category to mature quickly, with a fairly short time frame before reaching the Plateau of Productivity. This is consistent with a prediction that more mature customers that start building a strategic initiative today, on a suitable platform, will have a much higher success rate when these projects have deployed and sufficiently evolved over the next one to two years.
- The major challenge to implementation is scaling the implementations from proofs of concept or initial deployments to strategic and operationalized deployments that bring tangible business value. Over the past year, Gartner has observed a focus among major offerings on operationalization, and on enabling nondevelopers and non-data scientists not only to build, but also to maintain, improve and evolve the product over time.

User Recommendations

- Choose enterprise-ready platforms that support no-code options that allow nondevelopers and non-data scientists to do build, maintenance and evolution.
- Choose platforms that support multiple use cases, multiple bots, and multiple roles within the enterprise, and that have strong orchestration and synergies between these integrations.
- Choose platforms with flexibility in deployment and integration, so they can fit into your existing architecture.

Sample Vendors

Amelia; boost.ai; Cognigy; Haptik; Kore.ai; OneReach.ai; Pypestream; Rasa; ServisBOT; yellow.ai

Gartner Recommended Reading

[Consolidate Your Chatbot Initiatives Into a Single Enterprise Strategy](#)

[The 3 Decisions You Must Make Before You Begin a Chatbot Project](#)

[Craft a Chatbot Initiative Based on Your Business Requirements and Solution Complexity](#)

[2021 Strategic Roadmap for Enterprise AI: Natural Language Architecture](#)

Chatbots

Analysis By: Magnus Revang

Benefit Rating: High

Market Penetration: More than 50% of target audience

Maturity: Early mainstream

Definition

Chatbots are domain-specific or task-specific conversational interfaces that use an app, messaging platform, social network or chat solution for conversations. Chatbots range in use-case sophistication from simple, decision-tree-based, to implementations built on feature-rich platforms. They are always narrow in scope. A chatbot can be text-based or voice-based, or a combination of both.

Why This Is Important

Chatbots represent the No. 1 use of artificial intelligence (AI) in enterprises. Primary use cases are in customer service, human resources, IT help desk, self-service, scheduling, enterprise software front ends, employee productivity and advisory. Offerings in the market include developer self-service platforms, managed products, middleware offerings, integrated offerings and best-of-breed approaches.

Business Impact

Chatbots are the face of AI and will impact all areas with communication between machines and humans. Customer service is an area where chatbots are already very influential and will have a great impact on the number of service agents employed by an enterprise and how customer service is conducted. The change from “the user learns the interface” to “the chatbot learns what the user wants” has implications for onboarding, training, productivity and efficiency inside the workplace.

Drivers

- Chatbots in social media, service desk, HR or commerce, as enterprise software front ends and for self-service, are all growing rapidly.
- For enterprises, the main challenge with chatbots has been scaling and operationalizing them out of the proof-of-concept phase. As COVID-19 has accelerated adoption of chatbots, vendors seem to have “cracked the code” on operationalization. Vendors are now able to deliver multiple bots for multiple use cases, with no-code environments allowing multiple roles to participate in operationalization. This is creating a market for enterprise conversational AI platforms fueling the next generation of chatbots.

Obstacles

- Scaling and operationalizing still remain a challenge in some cases, due to lack of dedicated internal teams to work on continuous improvements.
- Figuring out the composition of teams, and the methodologies to iterate effectively, are still emerging practices with strong vendor dependency.
- Technology is improving at an astounding pace, but best practices on adoption and use of these technological advancements are still trailing, resulting in a lot of trial and error for enterprises.
- Selected vendors are sometimes unable to keep pace with the technology and the market dynamics.
- The vendor landscape comprises over 2,000 vendors, despite some consolidation during 2020. However, this is composed of many subcategories, majority of which are tactical. With this many vendors, the majority of chatbots will have to switch their underlying technology in the near to midterm future. Still a category of enterprise-grade platforms has emerged, with an estimated 120 vendors. These enterprise-grade platforms are becoming suitable as a more tactical choice.

User Recommendations

- Select an enterprise-grade platform to develop multiple use cases with orchestration of the assets needed.
- Focus on operationalization of chatbots as a product, with the necessary organization and roles in place, to evolve and maintain chatbots over time.

Sample Vendors

Amazon; Amelia; Cognigy; Google; IBM; Kore.ai; Microsoft; Pypestream; ServisBOT; Uniphore

Gartner Recommended Reading

[The 3 Decisions You Must Make Before You Begin a Chatbot Project](#)

[Consolidate Your Chatbot Initiatives Into a Single Enterprise Strategy](#)

[When Should I Use Embedded Conversational Assistants?](#)

Ontologies and Knowledge Graphs

Analysis By: Anthony Mullen

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Definition

Ontologies and knowledge graphs enable users to model a set of concepts, categories, properties and relationships in a particular domain. They support the development of a consistent terminology and allow complex relationships to be represented. They are often used to abstract away from underlying relational schemas, and can be seen as a flexible knowledge network with broad use across many NLT use cases. OWL and RDF are popular standards for ontology definitions.

Why This Is Important

As artificial intelligence (AI) and language automation projects proliferate data, content and architecture can become chaotic with concept models and metadata scattered across business units, implementations and vendors. Domain ontologies and knowledge graphs (KGs) are major AI methods to represent knowledge that is human readable, standardized and easily shareable, and abstracted from the underlying storage mechanism.

Business Impact

As investment and dependence on natural language technology (NLT) increases, ontologies and graphs will become a foundational approach for concept and relationship modelling, allowing:

- Better integration between disparate information systems and heterogeneous infrastructures
- Consistent labelling for AI projects where ontologies act as a canonical reference
- Broad application to use cases
- Support of multiagent systems
- More performant AI systems using composite AI

Drivers

- **Language automation drives usage** — Chatbots, insight engines, speech solutions and intelligent document AI systems are just some of the submarkets driving the broader language automation market. While some vendor solutions may weight structural (e.g., ontologies/KG's) and computational (e.g., DNNs) roles differently in their solution architecture, we see aggregate growth of ontologies and KGs both by vendors and clients. Major drivers, like conversational AI, have given ontologies and KGs renewed prominence — often used to model concepts like context, intent, events, entities and topics.
- **Better user experience in creating and managing ontologies and graphs** — Today, the heavy burden of humans alone managing ontologies is reduced by using machine learning (ML) to support their creation, maintenance and tuning.
- **Accelerated and broader use in data management** — Ontologies and knowledge graphs offer a flexible knowledge network, enabling broader use in both metadata management and data fabrics.
- **New approaches to composite AI in NLT** — Many semantic platforms, the torchbearers for this approach to concept modelling, have pivoted to integrate symbolic (e.g., ontologies, KGs) and subsymbolic approaches (e.g., deep neural networks [DNNs]) over recent years, which has improved NLT performance.
- **Improvement in ModelOps and AI orchestration techniques for graphs** — New techniques for distributed architecture and federated learning provide greater capacity to manage billions of triples, as well as secure data collaboration.

Obstacles

- **Ontologies and graphs are often a hidden mechanic** — Vendors using ontologies often don't make the information architecture directly available to buyers. Vendors should seek to make their ontologies available as an asset, in a marketplace, rather than a hidden mechanic for the end users they serve, and to use them to expand data and service partnerships in the NLT space.
- **Their value is not clear to novice buyers** — A major trigger for evolving to ontologies and graphs is when bottom-up approaches proliferate and create technical debt in information architecture. In the AI space, most buyers have really just begun to develop their AI data pipeline, and therefore don't realize the benefits of ontologies and graphs.
- **Knowledge graphs are time-consuming to develop** — Defining relationships across a domain requires detailed definitions. As domains expand the complexity of the graph increases.

User Recommendations

- Check to see if any large scale ontologies are available for their industry or within their existing applications.
- Ensure easy access to the data (read/write) for software engineers and data scientists.
- Master key metadata and classifications for all projects with an ontology supporting reuse and simpler networking of information.
- Represent product catalogues and services as ontologies and graphs to enable richer analytics and support collaborations with partners.
- Utilize them to speed up identification when there are multiple points to triangulate (faster than a relational database search).
- Capture and represent tacit and implicit knowledge from employees.
- Hire librarians to complement the data science team to manage ontological models.
- Examine ontology vendors and their wider offerings — specifically how they relate ontologies (definitions) to graphs (expressions of ontologies as data).

Sample Vendors

Expert.ai; Ontotext; PoolParty; SciBite; Smartlogic; Synaptica; TAIGER; Talkmap

Gartner Recommended Reading

[2021 Strategic Roadmap for Enterprise AI: Natural Language Architecture](#)

[Magic Quadrant for Insight Engines](#)

[What Is Data Fabric Design?](#)

[Hype Cycle for Data Management](#)

[Data Fabrics Add Augmented Intelligence to Modernize Your Data Integration](#)

Climbing the Slope

Semantic Search

Analysis By: Stephen Emmott

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Definition

Semantic search improves the relevance of search by processing the relationship between words — as a proxy for meaning — in addition to the words themselves, i.e., “things, not strings.” This serves to mediate between intent and outcome, raising and leveling the value of search for end users. Semantic search is a key part of insight engines as it augments the search technology that underpins them.

Why This Is Important

Search performance is essential for effective knowledge management, records management and support of automation involving data sourced from content in documents and records. Semantic search amplifies performance by analyzing the underlying meaning of documents/records, as well as the queries posed to retrieve them. This amplifies productivity through employee time spent, opportunity through connections and new ways of working, and reduces risks such as missing essential documents/records.

Business Impact

Semantic search impacts value streams across business functions and industry verticals. Use-case scenarios include:

- Facilitating employee experience by connecting employees to one another, or to information, based on their expertise, activities or need for knowledge.
- Facilitating customer experience by improving self-help in support of presale decisions or postsale support.
- Extending automation to processes currently restricted to employees receiving and processing documents manually.

Drivers

Progress is driven by:

- The continued need for improved search to support employee experience in the context of the digital workplace.
- Refining customer experience to stay ahead of expectations as well as increasing value and reducing costs.
- The pursuit of both augmentation and automation to create new ways of working for both employees and machines.
- The capability to extract textual content from audio and visual sources, thereby extending the reach of search to all content.
- Advances in word embedding (an application of machine learning) as a natural language processing technique to enable meaning to be processed reliably in the workplace.
- Advances in knowledge graphs, enabling explicit representation of the entities words represent, their attributes and relationships.

For these reasons and more, semantic search has reached 5 to 20% of its target audience as it leaves the Trough of Disillusionment and begins its ascent up the Slope of Enlightenment.

Obstacles

The progress of this innovation is obstructed by:

- Use and performance tend to be stronger in specific domains rather than across all, which holds back use in domains with fewer customers.
- While word embedding is flexible, rule-based approaches require further development, meaning those products that utilize a hybrid approach tend to be limited to specific languages.
- Performance improves with application, but much of this relates to confidential sources, resulting in confidential learning and adaptation that cannot be shared beyond individual customers.

- Not all products utilize a hybrid approach to techniques, which must involve a combination of techniques.
- Professional services from vendors and/or partners is essential to get started and, for many, to continue.
- Products that utilize knowledge graphs require them to be developed and maintained.
- Products that use word embedding require initial and subsequent training against content sources to remain current.

User Recommendations

To exploit this innovation:

- Treat search as a capability augmenting ways of working across multiple applications.
- Identify search capabilities across all applications and determine the level of semantic search provided, either at present or in terms of the roadmap.
- Steer review and selection processes to ensure your search and insight services include semantic search as a capability.
- Coordinate the development and maintenance of search and insight services to ensure a common hand behind configuration and training.
- Link your search and insight activities with your other NLT initiatives and in the context of the organization's wider data fabric to seek rationalization and consolidation where appropriate.
- Test the performance of semantic search in context. The performance of semantic search is highly dependent on its "semantic fabric."
- Engage and employ subject matter experts to contribute, ideally independently and proactively, to the maintenance of semantic search capabilities.

Sample Vendors

Expert.ai; Google; IBM; IntraFind; Microsoft; Ontotext; Semantic Web Company; ServiceNow

Gartner Recommended Reading

Magic Quadrant for Insight Engines

Critical Capabilities for Insight Engines

Text Autoclassification

Analysis By: Stephen Emmott

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Definition

Text autoclassification encompasses a range of techniques that automatically associate metadata with text to enrich the text's content and support processing. The target text can be of any length, from messages (such as tweets and emails) to whole documents. The metadata – typically in the form of keywords drawn from a taxonomy or ontology – facilitates the selection, analysis and automated processing of the text it represents.

Why This Is Important

Autoclassification facilitates automated processing of content (unstructured data) at scale. Reliance on employees to classify results leads to no classification (or variable quality) and an inability to scale/adapt. This obstructs the use or 'flow' of content. Advances in the application of machine learning (including neural networks) and knowledge graphs to natural language processing have enabled automated attribution that diminishes the need for human oversight.

Business Impact

A primary use case of autoclassification is to facilitate automation as a preparatory step for use by other applications that automate processes, e.g., RPA. Other uses center around locating text using the labels associated with it (e.g., enterprise search or recommendations) or analyzing text through labels. This innovation applies across all languages, industries and business functions where use cases and their fulfillment are dependent upon content and content services technologies.

Drivers

Progress is driven by:

- Demand due to growth in the quantity of content across many modes, e.g., audio and visual as well as textual, both internally in terms of what organizations manage, and externally in terms of what organizations consume.
- Expansion of the use cases content can serve, both in terms of employees working within the digital workplace, and automation.
- Advances in machine learning (including neural networks) and knowledge graphs, and particularly their application to natural language processing.
- Hybrid approaches that enable the combination of manual, rule-based and machine learning techniques.
- Availability both within applications (e.g., content services platforms and insight engines) and as separate point solutions.

For these reasons and more, text autoclassification has reached 5% to 20% of its target audience as it begins its journey up the Slope of Enlightenment.

Obstacles

Progress is obstructed by:

- The need for training to ensure performance, as training material becomes less representative as the content to be classified grows and changes.
- The need to create and maintain rules as a complement to machine learning.
- The range of solutions available for selection and use, and their presence in multiple and often differing markets, e.g., autoclassification is a capability found within content services platforms as well as insight engines.
- Multiple solutions in use throughout organizations without coordination, especially in terms of their configuration.
- The disconnect between subject matter experts and their ways of working, and the tools used to support autoclassification.
- The challenge of agreeing metadata schemas to determine which labels and values can be applied to content, as well as providing the required outcomes for training and rules.
- Ownership by IT as a tool rather than by subject matter experts as a solution.

User Recommendations

To exploit this innovation in support of the digital workplace:

- Establish a metadata schema and manually pilot this on a subset of your content to ensure proof of concept, and refine the schema.
- Start small and narrow in terms of metadata labels and permitted values, and grow values while constraining labels.
- Identify existing applications with the capability to autoclassify and coordinate their configuration and management.
- Use a separate point solution where no capability exists at present, or consolidate capabilities across multiple applications.
- Prepare a training set of representative content assets for both rule-based and machine-learning-based approaches.
- Test performance regularly using a carefully selected set of representative content assets, and use these to guide revision of your training set.
- Engage subject matter experts outside IT to own and lead deployment and maintenance.
- Ensure autoclassification is considered part of your natural language technology strategy.

Sample Vendors

BA Insight; Egress Software Technologies; Exaptive; Google; Microsoft; Mindbreeze; OpenText (Magellan); Pingar; Semantic Web Company (PoolParty)

Gartner Recommended Reading

[Market Guide for File Analysis Software](#)

[How to Use Semantics to Drive the Business Value of Your Data](#)

[Checklist for Ensuring Staff Can Find the Information They Need When Working Remotely](#)

[Magic Quadrant for Insight Engines](#)

Open-Source NLP Toolkits

Analysis By: Adrian Lee

Benefit Rating: High

Market Penetration: More than 50% of target audience

Maturity: Early mainstream

Definition

Open-source natural language processing (NLP) toolkits enable end users and commercial companies to review, modify or design the source codes for their own purposes, mostly free of charge. Open-source NLP toolkits address the most common problems of analyzing and processing large natural language corpora into structured data to support applications such as text analytics, chatbots or virtual assistants.

Why This Is Important

Open-source NLP toolkits have been available for over 20 years. Current releases incorporate a new generation of natural language technologies that provide value by optimizing business processes and operations. Applicable use cases are in business intelligence (text analytics), customer service (improving customer satisfaction, increasing engagement) and employee support (productivity applications, knowledge base management).

Business Impact

Open-source NLP toolkits enable:

- Rapid prototyping of conversational agents or applications.
- A test bed environment for enterprises to internally test their NLP requirements.
- Partial NLP capabilities for some conversational AI platform vendors.
- Enterprises to gain significant control over the application in order to develop customized solutions.
- Application vendors with conversational elements to develop their solutions for resale with limited fees.

Drivers

- Growing adoption of text analytics and other language-based solutions is driving strong enterprise interest in building solutions with open-source NLP toolkits.
- Some enterprises need to customize their integrations of NLT with their applications and use cases.
- There is a lack of availability of customization of custom-made and packaged NLT platforms without high professional services fees.
- The long-term viability and functionality of NLT platforms currently in the market are uncertain.
- NLP toolkits are mature, have broad user communities and are a NLP foundation widely accepted by enterprises and some conversational AI providers to enable the most common modes of linguistic analysis to help machines understand text.
- Core features of open-source NLP toolkits position them to be suitable, lower-cost platforms for prototyping and piloting conversational agents or applications.
- An increased proportion of open-source NLP toolkits will come with some pretrained intent models, languages and test suites to accelerate the project delivery for end users.

Obstacles

- Open-source NLP toolkit use cases are often focused toward supporting experimental research and noncommercial projects. Prototypes may not make it into production or be scaled up for commercial use.
- Open-source toolkits require enterprises to develop their own advanced in-house skills.
- To realize shorter-term business objectives, IT leaders still consider managed service providers that can better fulfill domain-specific needs and come with prebuilt intent models to accelerate deployment.
- Limitations can exist, especially where end users do not augment toolkits with suitable ML algorithms to improve the performance of the NLP output.
- Using open-source NLP toolkits is iterative and requires additional customization and integrations with enterprise applications before it delivers business benefits.
- Differences exist between self-service, managed service providers and open-source platforms in ontologies, taxonomies and domain specificity to drive contextual natural language understanding.

User Recommendations

Open-source NLP toolkits are relevant for organizations that:

- Want to build their own natural language technology stack by starting with a suitable toolkit to match their existing IT infrastructure.
- Possess their own in-house resources of data scientists and artificial intelligence (AI) technology engineers for NLP.
- Can bear a longer and more costly initial IT investment by using open-source NLP toolkits in order to benefit subsequently from lower total costs of ownership.

Sample Vendors

Apache OpenNLP; Intel; NLTK Project; PyTorch; spaCy; Stanford NLP Group

Gartner Recommended Reading

[Architecture of Conversational AI Platforms](#)

[Cool Vendors in Conversational AI Platforms](#)

[Guidance Framework for Evaluating Conversational AI Platforms](#)

[Emerging Technologies: Tech Innovators in Conversational AI and Virtual Assistants](#)

Neural Machine Translation

Analysis By: Bern Elliot

Benefit Rating: Transformational

Market Penetration: Less than 1% of target audience

Maturity: Adolescent

Definition

Neural machine translation (NMT) is the application of deep neural nets to automate the machine translation of text from one language to another.

Why This Is Important

Neural machine translation algorithms are enabling significantly higher quality translations than previous approaches. This is enabling new use cases for content that was previously too expensive or complex to translate. NMT is also being used to augment current human translation methods, allowing the translator to focus on the more difficult translation tasks.

Business Impact

Human translation typically costs between \$0.08 and \$0.25 per word, depending on the translator knowledge and skill required. NMT costs approximately \$20 per 1 million characters. For reference, a typical page is about 500 words or 3,000 characters. The most significant business impact has been to enable new applications due to the lower costs. Other impacted areas are areas where speed is critical or where NMT augments human translator tasks.

Drivers

- Core drivers for usage are reduced cost over human translation and the speed of translation if needed.
- There are also significant quality improvements NMT offers over previous techniques. This in turn enables a broad set of use cases across many business areas, including: text translation for documents, blogs, emails, memos, e-commerce and web content; online customer sales and support for customer problem tickets, chat forums and real-time queries; multimedia translation for training seminars, entertainment, audio and video clips; and real-time multimedia translation for video and phone meetings, one-to-ones and many-to-many.
- As NMT matures, secondary effects of the NMT technology are also driving new markets: NMT is being integrated with computer assisted translation tools (CAT) in a process called adaptive post-edit of machine translation (PEMT). Quality evaluation solutions are being developed to measure the accuracy of NMT translations. NMT hub services are being offered to arbitrage and route translation requests to the best fit NMT provider. Translation management systems (TMS) and the language services provider (LSP) market are shifting to adapt to NMT innovation. Website localization methods are using NMT for novel, proxy-based dynamic approaches. There are markets for data for customization of NMT models for verticals, languages and dialects.
- As a result, enterprises are rethinking their approaches to localization and globalization.

Obstacles

- NMT still has limitations on quality and the results are not as good as human translation for many use cases.
- NMT will not fit the requirements for multiple use cases, including those where accuracy is a critical requirement.
- Availability and quality of NMT models varies significantly between language pairs.
- The processes associated with effectively using NMT are still nascent both in products and in enterprise preparedness.
- Some enterprises worry about privacy and confidentiality of data sent to the NMT models.

User Recommendations

- Review where enterprise processes could be improved with NMT. This may involve modifying existing processes that require a high degree of human intervention.
- Consider where and how translation service providers are using NMT to improve their current service offerings.
- Collect translation data as this may be useful for customization of language models. This includes determining the format of the data so that it is usable for NMT model training.
- Evaluate NMT solutions based on your target language pairs and on text samples related to your actual documents and use cases. Not all NMTs are equally effective in all languages.
- If useful, there are methods for combining different NMTs to deliver different language pairs.

Sample Vendors

Amazon; Baidu; DeepL; Google; IBM; Lilt; Microsoft; SDL; SYSTRAN; Yandex

Gartner Recommended Reading

[Machine Translation Improvements Justify Re-examining Your Options](#)

[Market Guide for AI-Enabled Translation Services](#)

Insight Engines

Analysis By: Stephen Emmott

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Definition

Insight engines apply relevancy methods to discover, organize, describe and analyze data. This enables existing or synthesized information to be delivered interactively or proactively in the context of employees, customers or other constituents at timely business moments.

Why This Is Important

Insight engines use artificial intelligence (AI) to reinvent enterprise search, enabling enterprises to shift gear to semantic search, thereby unlocking patterns held within both unstructured and structured data, sourced internally and externally. Content and data are presented in context, as information, to deliver the insight needed for purposeful action. Insight engines provide the platform to gather content/data from myriad sources, enrich it for indexing, and query this via multiple touchpoints and integrations.

Business Impact

Insight engines are core to the digital workplace, amplifying digital dexterity by underpinning knowledge management. They apply across all domains (business functions and industry verticals), augmenting work in foundational and domain and situational scenarios; for example, intranet search or proactive recommendations within a CRM system. Insight engines also can be integrated with other software (for example, robotic process automation) to support the automation of workflows relating to content.

Drivers

Progress is driven by:

- Developments in semantic search, which drive the capability of insight engines, enabling content/data to be synthesized as information throughout the digital workplace
- Programmatic access to content (and other data sources) for various applications to support digital transformation (e.g., automation)
- The need to provide better user experiences with less friction, by including information in the applications where it is needed, bringing orientation, decision and action into one place/tool
- The need for an AI platform upon which multiple insight applications can be developed and delivered cohesively, and according to aspiration

- The fact that insight engines are now bundled with cloud office services provided by Microsoft (Microsoft 365) and Google (Google Workspace), providing a foundational service by default
- The need for custom-made applications aligned to domain and situational contexts, thereby providing deeper context and amplifying relevance

For these reasons and more, insight engines have reached more than 50% of target audience as the technology continues its ascent up the Slope of Enlightenment toward the Plateau of Productivity.

Obstacles

Progress is obstructed by the following:

- Deployment and maintenance is rarely done solo in-house, but rather involves the vendor and/or a third-party service provider, adding to the complexity and cost of professional services.
- Custom development is often required, expanding the time, skills and cost needed to attain higher aspirations for the technology.
- The range of connectors available for the ingestion of content and data varies from vendor to vendor. This constrains the choice of product according to available connectors, rather than the core purpose of semantic search, although custom connectors can be developed in most cases.
- Similarly, the range of prebuilt integrations into third-party applications is often limited, driving customers to further custom development.
- The complexity and expense of insight engines means they can be challenging for proof-of-concept initiatives, and usually entail a long-term (typically three-year) commitment once selected and deployed.
- Many organizations have yet to shift from simple to semantic search, leaving the employee benefits as desirable rather than essential for the majority of employees.

User Recommendations

To exploit this innovation:

- Place the beneficiaries — employees (or other constituencies as appropriate) — at the center by focusing the purpose of insight engines on ensuring that employees have the insight they need to decide and act, rather than searching.
- Personify employees, identify their use cases, and the applications they use to conduct their work, and the sources of content and data from which the information they need is retrieved or synthesized.
- Establish whether insight engines included in cloud office are sufficient for all employees and their use cases.
- Having just one insight engine is unlikely, so review and shape your portfolio to ensure you can address use cases across the foundational, domain and situational levels.
- Align expectations; at the highest level of maturity, insight engines synthesize information proactively in the context of work, but more typically they offer enhanced search.
- Ensure the steer of your portfolio is coordinated and linked to your wider natural language initiatives.

Sample Vendors

Coveo; Elasticsearch; Google; IBM; IntraFind; Lucidworks; Microsoft; Mindbreeze; Sinequa; Squirro

Gartner Recommended Reading

[Magic Quadrant for Insight Engines](#)

[Critical Capabilities for Insight Engines](#)

Speech Synthesis

Analysis By: Bern Elliot

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Definition

Speech synthesis is the artificial production of human speech. Earlier generations concatenated stored words or sounds (phones and diaphones). Current methods use a model of the vocal tract and other voice characteristics to produce entirely synthetic speech. Enhancements allow models to mimic specific speech patterns of individuals by tuning the synthesis model based on recordings.

Why This Is Important

High-quality speech synthesis allows vastly improved user experiences at a fraction of the cost of a human-recorded alternative. The current deep-learning-based approach uses acoustic models to produce waveforms and generate speech that are highly accurate. This approach was only developed in 2016. The rapid advancement of this technique since promises to enable many new and useful applications.

Business Impact

Business areas and applications with the following characteristics will have the most impact:

- High volumes of generated speech
- Speech content that changes frequently
- Speech where imitation of certain characteristics is desirable
- Ability to translate speech to other languages

Drivers

One of the most important use cases for speech synthesis is reading and communication aids for the blind and visually impaired. However, there are many other applications and these include:

- Improved user experiences with speech-enabled virtual assistants, chatbots and personal assistants
- Better-quality and less expensive audio narratives, including audio books, read-aloud children's stories with fun voices and so forth
- Target audiences based on both content and voice characteristics in website and other commercial audio information

- Improved usability of hands-free voice controls and interaction with voice assistants
- Voice controls to more effectively draw listener's attention to specific details
- Clearer and more engaging narration of news or information drawn from data, such as sports or business events
- More engaging characters and dialogues offered in computer games

Obstacles

- Recent models can mimic a specific individual's speech to the point that it is very difficult to identify it as a fake (aka deepfake). While there are legitimate uses for mimicry, it also poses ethical issues where it may be used to manipulate or deceive listeners.
- Users may find overly realistic virtual assistants "creepy."
- Speech synthesis models take expertise and time to develop and tune.

User Recommendations

- Business leaders should review their current applications that use speech and consider how this low-cost approach to speech generation, which combines low cost with high quality, can be best leveraged. However, planners should evaluate solutions before committing, because quality and latency issues may make some solutions less desirable than others.
- Leaders and those responsible for risk and security should consider where there may be exposures to voice mimicking. This can include situations where significant actions are taken solely based on verbal commands via phone. Personnel, clients and employees should be warned of the risk and enlisted in identifying situations at risk for this sort of fraud.

Sample Vendors

Acapela Group; Amazon; CereProc; Descript; Google; IBM; Microsoft

Gartner Recommended Reading

[Critical Capabilities for Cloud AI Developer Services](#)

[Top 10 Strategic Technology Trends for 2020: Human Augmentation](#)

Text Analytics

Analysis By: Shubhangi Vashisth, Stephen Emmott

Benefit Rating: Moderate

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Definition

Text analytics is the process of deriving business insight or automation from structured and unstructured text. This process can include determining and classifying the subjects of texts, summarizing texts, extracting key entities from texts, and identifying the tone or sentiment of texts.

Why This Is Important

Text analytics addresses a diverse range of uses, from general capabilities to extracting data from textual content, to industry-specific and line of business (LOB) use cases. Vendors in this market provide products that extract meaning and context from textual content. This can then be used to derive insights and action, either within the context of the product or by other products to which the data is made available.

Business Impact

Text analytics, when combined with various other analytics capabilities, can benefit the organization in the following areas:

- Preprocessing unstructured data for analysis.
- Automated document matching and classification (analyzing documents and matching metadata to them from a controlled vocabulary).
- Discovery and insight (indexing reports in preparation for natural language Q&A).
- Sentiment (analyzing notes, social media or transcripts to identify the author's attitude about a subject).

Drivers

Key drivers include:

- A surge in the volume of textual data, especially from sources other than traditional “documents” (such as instant messages, email and automatically extracted metadata), has fueled the evolution of text analytics.
- The desire to complement insights gleaned from analysis of structured numerical data with text-based facts for more robust predictive modelling.
- Advancements in nonsymbolic techniques.

Text analytics uses different combinations of technologies for different business use cases:

- Healthcare — medical records analysis by mapping key medical terms into a graph for analysis
- Insurance — identifying fraudulent claims by analyzing the narratives and identifying common individuals across claims
- Finance — gain insights on investments by monitoring public information sources and social media
- Legal — supporting contract review by extracting key terms and obligations from complex contracts
- Retail — monitoring product pricing across markets
- Marketing — monitoring brand loyalty and sentiment by analyzing social media feeds and customer feedback
- Law enforcement — forensic analysis of a body of documents by identifying key subjects and dates, and developing a chain of events
- Digital publishing — identifying related articles and developing a summary relevant to an article in progress

Obstacles

Several factors hinder the emergence of more pervasive, easy-to-use business solutions for text analytics:

- The technology is still maturing, and differentiation between the many overlapping vendors is too nuanced for those organizations without in-house expertise.

- Although easier to use, it is still challenging to incorporate solutions into an organization's wider digital platform, given the diversity of use cases and specialist skills needed to utilize and gain benefit.
- Most organizations lack a strategy to deal with semistructured and/or unstructured data. The approach to select tools for point solutions adds to the problem of tool sprawl.
- Training the solutions for specialized use cases is also a barrier in adoption.

User Recommendations

- Position text analytics as an NLT in the context of internal discussions so its role in augmentation and automation can be correctly framed.
- Identify and prioritize use cases that text analytics can address, and create an enterprise text analytics strategy.
- Review the text analytics market to acquaint yourself with its vendors, products and capabilities.
- Start with prepackaged products designed for business users to administer for well-established use cases, such as the voice of the customer (VoC). Cloud-based text analytics packages also offer a good way to experiment and enable easy adoption of the technology.
- Select products based on how well they suit specific business scenarios and their ability to integrate with other applications that work with unstructured data, such as conversational agents.
- Allow a realistic lead time to recruit text analytics talent. Consider working with a third-party analytics service provider for text analytics initiatives.

Sample Vendors

Amazon Web Services; Amenity Analytics; Bitext; Clarabridge; Google; IBM; Lexalytics; Megaputer; Microsoft; Proxem; SavantX

Gartner Recommended Reading

[Artificial Intelligence Primer for 2021](#)

[Market Guide for Text Analytics](#)

Toolkit: Supporting Data for the Selection of Text Analytics Vendors

Understanding Your Customers by Using Text Analytics and Natural Language Processing

Entering the Plateau

Speech Recognition

Analysis By: Anthony Mullen

Benefit Rating: Transformational

Market Penetration: More than 50% of target audience

Maturity: Mature mainstream

Definition

Speech recognition, commonly referred to as automated speech recognition (ASR) or speech to text (STT), digitally translates human speech into text for further processing.

Why This Is Important

Speech recognition democratizes access to systems and services by leveraging a communication modality users are already familiar with — their voice. This makes for a richer, more immediate and intuitive interface to engage with customers and employees. The technology also enables a variety of automation initiatives across the organization with training data. We see speech data being mined to extract latent business processes, intents and entities, question-and-answer pairs, etc.

Business Impact

Speech recognition enables intuitive, self-serve engagement with business processes and services, along with real-time compliance in conversations. With features like transcription, speaker verification, speech-powered chatbots, device control, and meeting support and coaching, speech recognition can be applied across departments and use cases. Additionally, speech metadata provides additional signals of customer behavior and mining of speech transcripts enables further automation.

Drivers

- **Expansion of services to richer voice suites:** With the core technology inching forward, vendors are beginning to expand services like multiparty authentication, talk over analysis, compliance, and privacy and security features, to extract additional metadata from speech (e.g., emotion). The technology impact is also expanding to functions like contact center, media monitoring and meeting room transcription, and verticals such as finance, media, legal and communications.

- **Conversational AI and IVR modernization:** The COVID-19 pandemic has revealed just how brittle the operational models were for customer service organizations relying on IVRs. As a result, in 2H20, there was a marked increase in the volume of end users modernizing IVR and telephony stacks with both direct-to-consumer speech automation and agent assist services.
- **Speech and user environment metadata improving analytics and experiences:** Along with the literal words spoken, there are other signals present in speech data, such as environment noise, syntax, cadence and emotional cues. The idea of multimodal input, to support better speech recognition, is also beginning to emerge in the translation space where visual imagery provides context and disambiguation to improve speech-to-text performance.
- **Privacy and trust:** While speech recognition has not yet received the same attention as computer vision with regard to AI legislation, we expect this to accelerate in the next two years.
- **New AI techniques indicating better speed of processing and ease of customizing models:** Large language models such as transformers (e.g., BERT, GPT-3), when used with transfer learning, are providing an easier path to custom models for organizations. Further, the use of GPUs with these technologies is also shortening transcription time, with NVIDIA-backed Deepgram managing to transcribe 10 hours of audio in just 40 seconds.

Obstacles

- **Difficulty with scaling speech systems:** While adoption and performance have accelerated, the increased rollout of speech recognition services has revealed gaps in capabilities when scaling systems across languages and business domains. However, we expect AI techniques such as transformer models and transfer learning to set new bars for speech recognition over the next two years.
- **Speech vendors' visibility in the buying cycle.** We see insight engines, conversational AI platforms, CX and CPaaS suites, and low-code/no-code platforms, all acting as a broker for speech recognition services. Consequently, speech vendors find it hard to form direct relationships and break out of being a tactical, commoditized choice for enterprises.

- **High-effort process:** Making speech to text work entails more than simply activating an off-the-shelf solution. Enterprise effort is required to attain high-quality experiences and accuracy. Organizations must plan for extended human involvement, to monitor, train and improve performance (especially around modeling proprietary business terms, dialects and noisy/complex environments).

User Recommendations

- Modernize your IVR with speech recognition and conversational AI, if your B2C organization is struggling with high call volumes.
- Use speech recognition and transcription as an accelerator to mine for automation assets (Q&A pairs, intents, entities, topics, processes) if you have a large corpus of recorded speech.
- Use edge-based, speech-to-intent models if you're looking to deploy autonomous ordering systems or interactive public services.
- Empower workers (e.g., field engineers or medical professionals) who have "hands busy, eyes busy," to engage with systems or take notes using speech rather than typing for entry, including email, reports and status updates.
- Use speech recognition to enable support for those with injuries or disabilities, and to simplify engagement with devices and services (e.g., electronics devices, automotive, smart home and IoT).
- Use speech recognition to facilitate compliance processes in regulated industries.

Sample Vendors

Alibaba Group; Amazon; Cedat85; Dasha AI; Deepgram; Google; IBM; Intelligent Voice; Microsoft; Speechmatics

Gartner Recommended Reading

[2021 Strategic Roadmap for Enterprise AI: Natural Language Architecture](#)

[Magic Quadrant for Cloud AI Developer Services](#)

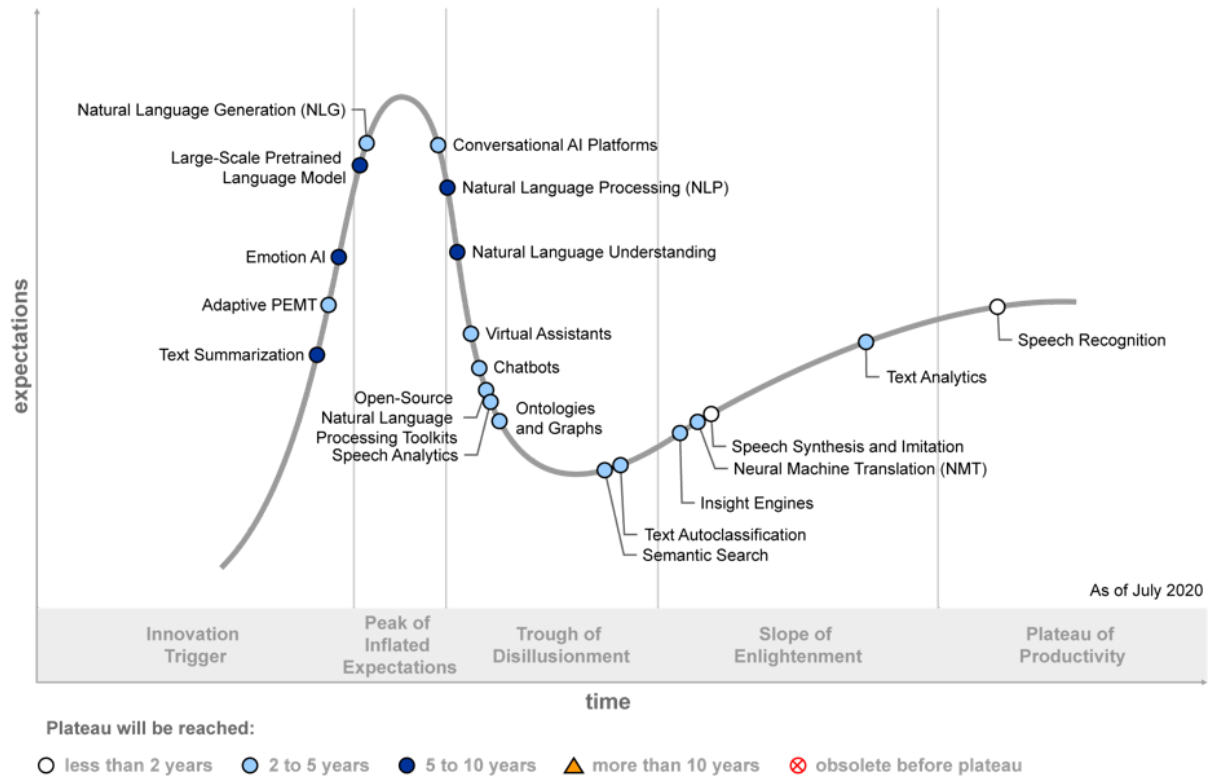
[Architecture of Conversational AI Platforms](#)

[Cool Vendors in Conversational and Natural Language Technologies](#)

Appendixes

Figure 2: Hype Cycle for Natural Language Technologies, 2020

Hype Cycle for Natural Language Technologies, 2020



Source: Gartner
ID: 467879

Gartner

Source: Gartner (July 2020)

Hype Cycle Phases, Benefit Ratings and Maturity Levels

Table 2: Hype Cycle Phases

(Enlarged table in Appendix)

Phase ↓	Definition ↓
<i>Innovation Trigger</i>	A breakthrough, public demonstration, product launch or other event generates significant media and industry interest.
<i>Peak of Inflated Expectations</i>	During this phase of overenthusiasm and unrealistic projections, a flurry of well-publicized activity by technology leaders results in some successes, but more failures, as the innovation is pushed to its limits. The only enterprises making money are conference organizers and content publishers.
<i>Trough of Disillusionment</i>	Because the innovation does not live up to its overinflated expectations, it rapidly becomes unfashionable. Media interest wanes, except for a few cautionary tales.
<i>Slope of Enlightenment</i>	Focused experimentation and solid hard work by an increasingly diverse range of organizations lead to a true understanding of the innovation's applicability, risks and benefits. Commercial off-the-shelf methodologies and tools ease the development process.
<i>Plateau of Productivity</i>	The real-world benefits of the innovation are demonstrated and accepted. Tools and methodologies are increasingly stable as they enter their second and third generations. Growing numbers of organizations feel comfortable with the reduced level of risk; the rapid growth phase of adoption begins. Approximately 20% of the technology's target audience has adopted or is adopting the technology as it enters this phase.
<i>Years to Mainstream Adoption</i>	The time required for the innovation to reach the Plateau of Productivity.

Source: Gartner (July 2021)

Table 3: Benefit Ratings

<i>Benefit Rating</i> ↓	<i>Definition</i> ↓
<i>Transformational</i>	Enables new ways of doing business across industries that will result in major shifts in industry dynamics
<i>High</i>	Enables new ways of performing horizontal or vertical processes that will result in significantly increased revenue or cost savings for an enterprise
<i>Moderate</i>	Provides incremental improvements to established processes that will result in increased revenue or cost savings for an enterprise
<i>Low</i>	Slightly improves processes (for example, improved user experience) that will be difficult to translate into increased revenue or cost savings

Source: Gartner (July 2021)

Table 4: Maturity Levels

(Enlarged table in Appendix)

<i>Maturity Levels</i> ↓	<i>Status</i> ↓	<i>Products/Vendors</i> ↓
<i>Embryonic</i>	In labs	None
<i>Emerging</i>	Commercialization by vendors Pilots and deployments by industry leaders	First generation High price Much customization
<i>Adolescent</i>	Maturing technology capabilities and process understanding Uptake beyond early adopters	Second generation Less customization
<i>Early mainstream</i>	Proven technology Vendors, technology and adoption rapidly evolving	Third generation More out-of-box methodologies
<i>Mature mainstream</i>	Robust technology Not much evolution in vendors or technology	Several dominant vendors
<i>Legacy</i>	Not appropriate for new developments Cost of migration constrains replacement	Maintenance revenue focus
<i>Obsolete</i>	Rarely used	Used/resale market only

Source: Gartner (July 2021)

Document Revision History[Hype Cycle for Natural Language Technologies, 2020 - 6 July 2020](#)**Recommended by the Authors**

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[Understanding Gartner's Hype Cycles](#)[Create Your Own Hype Cycle With Gartner's Hype Cycle Builder](#)[Market Guide for Text Analytics](#)[Market Guide for AI-Enabled Translation Services](#)[Magic Quadrant for Insight Engines](#)[Magic Quadrant for Cloud AI Developer Services](#)[Architecture of Conversational AI Platforms](#)

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Table 1: Priority Matrix for Natural Language Technologies, 2021

Benefit	Years to Mainstream Adoption			
	Less Than 2 Years	2 - 5 Years	5 - 10 Years	More Than 10 Years
Transformational	Conversational AI Platforms Speech Recognition	Neural Machine Translation Virtual Assistants	Emotion AI Natural Language Understanding Transformers	NSLMs
High	Chatbots Intelligent Document Processing	Insight Engines Natural Language Generation Ontologies and Knowledge Graphs Open-Source NLP Toolkits		
Moderate	Speech Synthesis	Adaptive PEMT Semantic Search Speech Analytics Text Analytics Text Autoclassification	Text Summarization	
Low				

Source: Gartner (July 2021)

Table 2: Hype Cycle Phases

Phase ↓	Definition ↓
<i>Innovation Trigger</i>	A breakthrough, public demonstration, product launch or other event generates significant media and industry interest.
<i>Peak of Inflated Expectations</i>	During this phase of overenthusiasm and unrealistic projections, a flurry of well-publicized activity by technology leaders results in some successes, but more failures, as the innovation is pushed to its limits. The only enterprises making money are conference organizers and content publishers.
<i>Trough of Disillusionment</i>	Because the innovation does not live up to its overinflated expectations, it rapidly becomes unfashionable. Media interest wanes, except for a few cautionary tales.
<i>Slope of Enlightenment</i>	Focused experimentation and solid hard work by an increasingly diverse range of organizations lead to a true understanding of the innovation's applicability, risks and benefits. Commercial off-the-shelf methodologies and tools ease the development process.
<i>Plateau of Productivity</i>	The real-world benefits of the innovation are demonstrated and accepted. Tools and methodologies are increasingly stable as they enter their second and third generations. Growing numbers of organizations feel comfortable with the reduced level of risk; the rapid growth phase of adoption begins. Approximately 20% of the technology's target audience has adopted or is adopting the technology as it enters this phase.
<i>Years to Mainstream Adoption</i>	The time required for the innovation to reach the Plateau of Productivity.

Phase ↓

Definition ↓

Source: Gartner (July 2021)

Table 3: Benefit Ratings

Benefit Rating ↓	Definition ↓
Transformational	Enables new ways of doing business across industries that will result in major shifts in industry dynamics
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Source: Gartner (July 2021)

Table 4: Maturity Levels

Maturity Levels ↓	Status ↓	Products/Vendors ↓
Embryonic	In labs	None
Emerging	Commercialization by vendors Pilots and deployments by industry leaders	First generation High price Much customization
Adolescent	Maturing technology capabilities and process understanding Uptake beyond early adopters	Second generation Less customization
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Mature mainstream	Robust technology Not much evolution in vendors or technology	Several dominant vendors
Legacy	Not appropriate for new developments Cost of migration constrains replacement	Maintenance revenue focus
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Source: Gartner (July 2021)