Leveraging AI for Adaptive Business Strategy: Analyzing the Role of Technical and Business Applications across Departments

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ABSTRACT,

Strategic integration of artificial intelligence (AI) into corporate operations creates chances for increased efficiency, competitive advantage, and innovation. In order to answer the research question, "How do different AI technologies align with and enhance specific business functions within an organization?" this study examines how particular AI technologies complement and improve business functions. Expert assessments were used to analyze important company domains, such as marketing, R&D, manufacturing, and cybersecurity.

Using a cross-tabulation of verified AI keyword lists, experts evaluated AI technologies—Machine Learning, Image Recognition, Speech Recognition, and Knowledge-Based Systems—based on their influence across multiple business fields. The results show that machine learning is widely applicable across industries, but it is especially important in cybersecurity and manufacturing, where it supports threat identification and predictive analytics. In manufacturing and production, image recognition has become essential for automation and quality control, and knowledge-based systems help distribution and logistics decision-making. In customer-facing positions like marketing and sales, speech recognition is highly desired despite being more specialized. It makes chatbots and staff communication tools possible. Cybersecurity departments use technology methods like machine learning and knowledge-based systems to make threat detection, response, and system recovery easier. As a result of their ability to facilitate strategic decision-making and promote effective operations, knowledge-based system technologies, such as Human Performance Augmentation and Commonsense reasoning for HR, and systems such as Business process management and Expert systems for R&D have become indispensable in these departments.

This report provides useful information for businesses looking to allocate AI resources as efficiently as possible. Some technologies, such as machine learning, exhibit broader importance, while others, like speech recognition, exhibit specific uses. This report supports strategic AI investments that promote organizational innovation and efficiency by elucidating AI's function across departments and providing expert insights.

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Keywords

Artificial Intelligence, AI Technologies, Technical AI Methods, Speech Recognition, Image Recognition, Machine Learning, Knowledge-Based Systems, Marketing/Sales, Research & Development (R&D), Manufacturing and Production, Human Resources, Distribution and Logistics, Cyber-Security, Cross-Tabulation, Business Functions, Organizational Strategy, AI Adoption, Departmental AI Integration

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1. INTRODUCTION

Businesses are depending more on cutting-edge technologies to glean insights from large datasets and improve strategic decision-making as artificial intelligence (AI) transforms the field of business analytics (Balbaa & Abdurashidova, 2024). Recent studies have looked at AI adoption in enterprise settings in an effort to evaluate its integration and operational impact, given the notable expansion of AI tools such as ChatGPT (Carobene et al., 2024). Despite the fact that several studies examine the trends in AI adoption, little is known about how particular AI technologies relate to particular business functions, which would allow organizations to successfully utilize AI's potential across departments (Dahlke et al., 2024).

By investigating how AI technologies from methods like machine learning, image recognition, speech recognition, and knowledge-based systems complement and improve business operations, this study aims to close this gap. We examine AI's function in crucial domains such as marketing, R&D, manufacturing, and cybersecurity using a cross-tabulation methodology. By classifying and evaluating AI technologies according to their applicability to different business tasks, we offer insights into the best way to allocate AI resources, which can help organizations match technology expenditures with strategic objectives.

"How do different AI technologies align with and enhance specific business functions across various departments within an organization?" is the central question guiding this study. We address this by using pre-validated keyword lists that cover a variety of technological approaches and AI applications, guaranteeing a thorough foundation for research. These lists will be reviewed by subject-matter experts, who will then refine them to represent the most pertinent AI technologies that are suited to certain business requirements. Our final keyword lists precisely capture the most important AI applications for every business context thanks to our expert-driven validation process.

This study's methodology entails cross-tabulating business-oriented departments like R&D, manufacturing, marketing, human resources, logistics, and cybersecurity with technical AI techniques like image and speech recognition. The study offers a functional-level perspective on how particular AI techniques might serve various business tasks by contrasting AI technologies within this framework. Furthermore, we assess both specialized and widely applicable AI technologies to see how well they fit into each business domain.

The ultimate goal of this research is to assist companies in strategically aligning AI investments with departmental requirements, maximizing resource allocation and decision-making for AI adoption. The results of the study will show how certain AI technologies improve efficiency, innovation, and competitiveness across business functions, providing a road map for businesses to make use of AI's potential across their organizational structures.

1.1 Research Background

Organizational procedures have changed due to the quick development of AI technology, opening up new avenues for better decision-making, operational efficiency, and competitive positioning (Balbaa & Abdurashidova, 2024). Organizations must carefully consider how AI may be integrated across critical organizational areas, such as marketing, R&D, manufacturing, human resources, logistics, and cybersecurity, in order to effectively utilize these capabilities. The significance of matching AI investments with particular departmental needs is highlighted by the fact that every department presents unique opportunities and obstacles for integrating AI.

General implementation issues like employee reluctance, talent shortages, and technology limitations have been extensively covered in recent research on AI adoption (Carobene et al., 2024; Benbya, Davenport, & Pachidi, 2020). For example, research by Dwivedi et al. (2021) and Gursoy et al. (2019) highlights that in addition to technical aspects like infrastructure and data quality, organizational readiness and employee acceptance have a major impact on AI adoption. Although these studies give us a basic knowledge of how organizations are responding to AI, they frequently don't focus on how certain AI technologies may serve particular business tasks in a unique way.

There is still a great deal to learn about how certain AI technologies fit into particular business processes. To maximize return on investment and support strategic objectives, it is imperative that AI projects are in line with departmental goals. Despite the wide range and widespread use of AI applications, many studies fail to take into account the particular requirements and features of different departments. Knowing how customized AI solutions can improve particular departmental activities is crucial as businesses look for strategic AI integration.

The literature currently in publication usually treats artificial intelligence (AI) as a single, broad notion without distinguishing between methods like knowledge-based systems, machine learning, image recognition, and speech recognition. Each of these technologies has special uses that can improve different aspects of corporate operations; for instance, speech recognition can revolutionize customer service in marketing, while machine learning can help with predictive modeling in R&D (Dwivedi et al., 2021). A large portion of the

literature overlooks important insights into how these technologies might improve departmental operations by failing to address the unique features of these AI techniques.

By analyzing how particular AI technologies relate to corporate operations, this study seeks to close these gaps. This study systematically assesses how AI technologies like machine learning, image recognition, and speech recognition can improve operations within departments like marketing, R&D, and cybersecurity. It does this by using pre-validated AI keyword lists from reliable sources such as IEEE (Ieee, n.d.), WIPO Elsevier (Elsevier), IEEE R&L (IEEE Robotics and Automation Society, 2024), AAA (AAAI-24 keywords, 2023), and WIPO (PATENTSCOPE artificial intelligence index, n.d.). This study helps firms make well-informed AI investment decisions by emphasizing key alignments and offering a framework for strategic and functional AI adoption.

1.2 Research Objectives

This study's main goal is to investigate how certain AI technologies might be strategically matched with specific business operations in order to optimize organizational impact. Examining AI techniques like speech recognition, image recognition, machine learning, and knowledge-based systems as well as how they could improve business divisions including marketing/sales, research and development, manufacturing, human resources, distribution, and cyber-security is the main goal of this study. The study intends to provide practical insights that help businesses choose AI investments to improve departmental performance using cross-tabulation analysis.

Finding the AI technologies that have the biggest potential to affect every company function is one particular objective. In order to do this, a structured survey will be used to collect expert comments. Participants will evaluate the application and usefulness of AI keywords across different departments. A thorough grasp of AI's function in various business contexts will be provided by the data gathered, which will enable an examination of both general and specialized AI applications across organizational contexts.

The survey's expert-driven methodology makes use of the knowledge of AI specialists to inform the classification and use of AI technologies, hence defining the study's scope. Although this dependence on professional judgment is beneficial, the subjective character of these viewpoints raises the possibility of bias. Furthermore, this study focuses on how particular AI techniques fit with specified business tasks rather than the quantifiable effects of AI adoption on organizational performance or technological implementation issues.

By accomplishing these goals, this study will improve knowledge of function-specific AI applications in academia and in practice. The results of the study will provide useful suggestions for businesses looking to maximize their AI strategy across several divisions.

2. THEORETICAL FRAMEWORK

2.1 AI Technologies and Business Function Alignment

Examining how particular AI approaches are incorporated into organizational procedures is necessary to comprehend how AI technologies might improve different business operations. Businesses are using AI more and more to accomplish objectives including encouraging creativity, optimizing processes, boosting productivity, and assisting with data-driven decision-making. These applications cover a variety of departments, each with its own requirements and potential.

This study examines how AI aligns with business operations using a cross-tabulation of validated keywords guided by experts. This method divides AI's function into three primary categories rather than depending only on information from corporate websites: (i) Artificial Intelligence (AI) for Customer Engagement: By offering insights into customer behavior and preferences, techniques like sentiment analysis and natural language processing improve marketing and sales; (ii) AI for Innovation and Development: Machine learning and cognitive computing support R&D in predictive modeling and simulations; and (iii) AI for Process Efficiency: Technologies like robotic process automation (RPA) optimize manufacturing and logistics by cutting costs and boosting efficiency.

Understanding AI's complete organizational impact requires an awareness of the unique advantages it offers each department. AI's contributions to cybersecurity or human resources, for example, are probably going to be very different from how it is used in marketing and sales. It is easier to see how AI may effectively serve departmental goals when it is viewed as a collection of specialized tools rather than a single technology.

In order to provide particular insights into the AI techniques that are most beneficial for each business function, this study classifies AI technologies based on their departmental relevance, following the methodology established by Dahlke et al. (2024). This study examines the ways in which AI complements different departments in order to test the notion that the impact of AI varies greatly depending on the particular business function it serves. This framework aims to provide comprehensive insights into these functional alignments, emphasizing

the customized role of AI inside corporate contexts. It has been confirmed by expert feedback on pre-selected keywords.

3. METHODOLOGY

Using a mixed-methods approach, this study validates and classifies AI keywords by combining quantitative and qualitative data, finally providing insights into how AI technologies complement particular business activities. Two survey rounds are used in the process to collect both expert input and numerical ratings. This method offers a thorough grasp of AI's function in different business divisions and guides the creation of focused AI strategies. The research strategy, data collection techniques, and analytical approaches are described below.

3.1 Research design

An effective framework for the categorization and verification of AI keywords is established by this mixed-methods approach. Rating scales are used to gather quantitative data, which enables statistical analysis of each keyword's importance across predetermined categories. At the same time, open-ended questions collect qualitative information from AI specialists, revealing subtleties that augment and supplement the numerical data.

In the first survey round, the primary objective was to classify each AI keyword The main goal of the first survey round was to ensure that every AI keyword was appropriate by classifying it inside the appropriate Technical AI Methods and Business Departments. Appendix A provides a comprehensive list of the original keywords assessed in this round, demonstrating the range of terms taken into consideration prior to refining. Each keyword was given a rating by experts on a scale of 0 to 2, where 0 meant "No Fit," 1 meant "Moderate Fit," and 2 meant "Strong Fit." While business and application-oriented AI keywords were grouped by departments such as Marketing/Sales, R&D, Manufacturing, Human Resources, Distribution and Logistics, and Cyber-Security, technical AI keywords were grouped under techniques like knowledge-based systems, image recognition, machine learning, and speech understanding. Appendix B includes the qualitative questions, expert responses, and summary tables.

Cross-tabulation analysis was the main emphasis of the second survey round, which is described in section 3.1.2. The top three keywords for each category that were chosen for this round based on average ratings from the initial poll are included in Appendix C. These keywords enabled a focused cross-tabulation analysis between Business and Application-Oriented AI keywords and Technical Methods, and between specific Technical AI keywords and Business Departments. By gathering both broad trends and focused insights about AI's role in business operations, this two-stage process offered a balanced perspective of both general and specific AI applications.

3.1.1 Survey Process - Round 1: Keyword Validation and Categorization

Validating and classifying a carefully selected set of AI keywords that were intended to correspond with both technical AI methodologies and particular commercial application areas was the major objective of the survey's first phase. The objective was to make sure that every keyword appropriately represented AI applications related to various business processes and fell within the relevant technical area.

Employing a Likert-type scale with a range of 0 to 2, where 0 denoted "No Fit," 1 "Moderate Fit," and 2 "Strong Fit," participants scored each keyword according to how well it fit into predetermined categories. Respondents were shown two different lists of AI keywords. Participants classified the terms in the first list, which included terms related to certain AI approaches and techniques, into one of four technical categories: speech understanding, machine learning, image recognition, and knowledge-based systems. One of six business departments—Human Resources, Manufacturing and Production, Distribution and Logistics, Marketing and Sales, Research and Development (R&D), and Cyber-Security—was allocated by respondents to the second list of business and application-oriented keywords. A systematic evaluation of AI's compatibility with particular organizational functions was made possible by this dual classification methodology.

Participants answered three qualitative questions in addition to the quantitative ratings, which offered more in-depth information about the applicability and usefulness of AI keywords:

(i) Participants recommended any keywords they believed were missing from the lists, mentioning the business department or technical AI approach in question and, if feasible, providing a succinct explanation for their inclusion.

(ii) Respondents gave each business area a rating of "Not Used," "Slightly Used," or "Heavily Used" in order to evaluate AI usage across departments, providing a useful viewpoint on AI's organizational applications.

(iii) Respondents provided qualitative information about the specific AI systems, tools, or techniques they use in their workplaces.

The rating and categorization data, as well as answers to these open-ended questions, are shown in Appendices A and B. These qualitative observations clarified the applicability and influence of AI techniques across several business domains, giving the quantitative ratings perspective. The results of this round improved the keyword lists for the second round and indicated possible directions for additional research, as covered in the Results and Discussion sections.

3.1.2 Survey Process - Round 2: Cross-Tabulation and Refinement

In the second survey round, a cross-tabulation analysis was employed to refine the AI keyword lists. Participants assessed how effectively the top three AI keywords in each of the Technical and Business categories—which are listed in Appendix C—aligned with different business functions during this phase. In the end, this round produced a more useful AI keyword list that was in line with real-world applications by allowing for both general and specialized insights.

A thorough and contextual understanding of AI's involvement in various business tasks is ensured by this research design, which is bolstered by the keywords in Appendix C and the qualitative replies in Appendix B.

3.2 Data Collection Methods

The data for this study were initially obtained and categorized using ChatGPT, drawing from reputable sources such as WIPO, Elsevier, IEEE, and IEEE RA&L, to ensure a solid basis of AI terminology. The final keyword lists from the aforementioned sources are shown in Tables S.1 and S.2. Business and application-oriented AI keywords are listed in business departments in Table S.2, whereas technical AI keywords are listed in technical AI methods in Table S.1. The surveys were then administered using Qualtrics, which provided a structured framework for collecting both quantitative scores and qualitative input.

The study targeted AI specialists listed by the University of Twente's Digital Society Institute using purposive sampling (University of Twente, n.d.). This screening procedure ensured that participants possessed the skills and background required to meaningfully assess and categorize AI keywords. Fourteen experts covering a variety of AI-related fields, such as Applying AI, Developing AI, and Researching AI, participated from faculties including BMS, EEMCS, ET, ITC, and TNW. To expedite the survey process, emails were utilized to send out initial invites and then follow-up reminders to encourage participation. In round two, the same experts took part, and through cross-tabulation exercises, they enhanced their assessments and provided additional recommendations.

3.3 Data Analysis Approach

Responses were processed using Qualtrics and Excel following data collection with Qualtrics (Qualtrics, n.d.), with an emphasis on data preparation and cleaning to guarantee accuracy. The main analytical technique that was then used to identify the connections between Technical Methods and Business Departments was cross-tabulation. The study was able to determine which AI technologies are most pertinent to particular departments thanks to this analysis, which also offered insights into how these technologies can be strategically used in organizational settings. An example of this of the keyword phonetics can be seen in Table D.1. ‘’The index list of the keyword Phonetics’’ in Appendix D. The conclusion made in this table is that the keyword Phonetics is the most fitting in the department of R&D. Doing this with all keywords on a large scale give a good indication of the best by AI-expert rated technical keywords for each department.

Because it allowed for iterative expert feedback, the two-round survey design improved dependability. Cross-validation of the keyword lists was made possible by this structure, guaranteeing their precision and applicability. By enabling direct comparisons between broad and specialized keyword relevance across several business activities, cross-tabulation strengthened validation even more.

4. RESULTS

4.1 Introduction to the Results

The primary goal of this study is to evaluate how specific AI technologies can support and enhance business functions across different organizational departments. Through the classification and application of selected AI terms, as validated by AI specialists, this research aims to deepen understanding of AI’s strategic potential in areas such as marketing, sales, and cybersecurity. Using a two-round survey approach, which combined quantitative ratings and qualitative insights, the study conducted an in-depth analysis of AI’s relevance to various organizational functions.

This Results section presents the findings from each survey round in alignment with the study’s objectives and research questions. It begins with an overview of the gathered data, including descriptive and inferential statistics from the quantitative component that assessed the relevance of selected AI keywords to distinct technical methods and business divisions.

Following this, the section includes cross-tabulation data, detailing the alignment of AI keywords with both general technical AI methods and specific business functions. These cross-tabulations provide key insights into the perceived relevance and application of AI technologies across departments. Finally, qualitative insights from experts offer additional perspectives on AI applications within business settings, contextualizing the quantitative findings and providing a broader understanding of possible areas for future refinement.

4.2 Demographics of Respondents

Purposive sampling was used in the study to target AI specialists from the University of Twente's Digital Society Institute (University of Twente, n.d.). To make sure that the participants had the necessary knowledge to properly assess and classify AI keywords, this selection process was used. By concentrating on this specific group, the study sought to obtain opinions from people who have specific expertise in AI-related domains, improving the accuracy and applicability of the findings.

All the AI experts listed by the University of Twente's Digital Society Institute were thus invited to participate in the first round of the survey, which consisted a total of 187. These experts were divided into three categories: Applying AI (155 experts), Developing (for) AI (134 experts), and Researching AI (68 experts). Keep in mind that specialists may fit into more than one category. An email was sent to each of these experts, along with a reminder to promote involvement. Only 14 of the 48 experts who answered the first round's questions were complete enough to be analyzed. The remaining participants might not have met the predetermined requirements, including expertise level or relevance to the study's subject, or they might have dropped out or supplied insufficient data.

Of the 48 experts who took part in the questionnaire, thus 14 were deemed valid for analysis and represented a wide range of artificial intelligence-related fields. These areas—Applying AI, Developing AI, and Researching AI—reflect several facets of the AI lifecycle and present a range of viewpoints on the technology. The University of Twente's Behavioral, Management and Social Sciences (BMS), Electrical Engineering, Mathematics and Computer Science (EEMCS), Engineering Technology (ET), Geo-Information Science and Earth Observation (ITC), and Science and Technology (TNW) faculties represent the respondents. This diversity in the faculty's affiliation and professional specialty helps to provide a holistic perspective on AI advancements and applications, allowing for a well-rounded evaluation of the AI keywords being examined.

Subsequent analysis was then at last conducted using these 14 legitimate responses. These 14 experts were invited to participate once more in the second round, and six of them answered the follow-up. In order to ensure that the data was reliable and correct, this two-round process was crucial for honing and confirming the AI keyword lists.

4.3 Survey Results Round 1

4.3.1 Survey Round 1: Technical AI Keywords and Business and Application-Oriented AI Keywords Categorization

Using four main techniques—speech recognition, image recognition, machine learning, and knowledge-based systems—the first survey round found the most popular technical AI keywords. The top keywords for each approach were chosen based on respondents' applicability ratings, as indicated in Table A.2 in Appendix A. The most influential AI technologies in each technical category are highlighted by these selections. For instance, the greatest ratings for speech recognition went to Deep Learning Algorithms, Speech Synthesis, and Phonetics, highlighting the significance of sophisticated voice processing techniques in this field. Applications in security and intricate picture interpretation were reflected in the prioritization of picture Motion Analysis, Face Recognition, and Scene Understanding for Image Recognition. Popular machine learning algorithms like gradient tree boosting, reinforcement learning, and support vector machines highlight how versatile machine learning is for a variety of categorization and prediction applications. Expert systems, rule-based systems, and commonsense reasoning have all become crucial components of knowledge-based systems for facilitating organized decision-making in challenging situations.

Top Business and Application-Oriented AI Keywords from different business departments were also categorized by the survey. Each department—Marketing/Sales, Research & Development (R&D), Manufacturing and Production, Human Resources, Distribution and Logistics, and Cyber-Security—benefits from unique AI technologies designed to meet its operational requirements, as shown in Table A.4 in Appendix A. For example, in marketing/sales, chatbots, recommender systems, and customer relationship management (CRM) were shown to be essential for improving client engagement and customisation. To promote innovation and guarantee model transparency, R&D uses technologies like Explainable AI, Digital Twins, and Virtual Prototyping. Data analytics, collaborative robots, and automated manufacturing systems facilitate effective resource management and operational control in manufacturing and production. To increase worker productivity and streamline HR operations, human resources leverages technologies like

social robots, business process management, and human performance augmentation. AI's significance in streamlining supply chain workflows is highlighted by keywords related to distribution and logistics, such as Automated Supply Chain Systems, Data Analytics for Manufacturing and Logistics, and Business Process Management. Lastly, to improve resilience and safeguard infrastructure, Cyber-Security integrates Cyber Threat Intelligence, System Recovery, and Surveillance Robotic Systems.

Appendix A contains descriptions of each keyword's unique purpose within the Technical Methods and Business Departments. These thorough explanations provide insightful information about how each tool fits with departmental objectives.

4.3.2 Survey Results Round 1: Patterns of AI Utilization Across Business Area

Research and Development (R&D) is the department that uses AI technologies the most among respondents, according to the first survey round results, which are shown in Table B.2. ‘’Survey Responses AI Usage in Various Business Departments’’ with the associated statistics in Table B.3. ‘’Statistics AI Usage in Various Business Departments’’ of Appendix B. This is supported by a median and mode of 3, as well as an average usage rating of 2.71. The substantial role that AI plays in R&D, where intensive AI applications are probably incorporated into innovation and problem-solving processes, is highlighted by the respondents' continuous reporting of high usage.

With medians and modes continuously around 1, the departments of Marketing/Sales, Human Resources, and Distribution and Logistics, all have an average usage rating of 1.36. Manufacturing and Production, and Cyber-security, have a little higher average of 1.57 and 1.71 respectively. Given that most respondents report little to no AI interaction, this homogeneity suggests a typically low adoption of AI across these functions. These results imply that the adoption of AI is still in its infancy or that its disruptive potential may not yet be completely realized in these fields.

4.3.3 Survey Results Round 1: Analysis of AI Techniques and Systems Reported by Respondents

A variety of AI strategies were mentioned by respondents, ranging from basic tools like neural networks for pattern recognition and predictive modeling to more specialized methods like PUF assaults and phishing detection (see Table B.4 in Appendix B). Transparency is essential, particularly in security-related disciplines, as demonstrated by interpretability techniques like SHAP. This variety shows how AI can be used to a wide range of tasks and industry-specific requirements, with professionals customizing solutions to achieve certain corporate goals. Appendix B contains information on specific AI techniques, such as neural network types and security-oriented techniques.

4.4 Survey Results Round 2

4.4.1 Survey Results Round 2: Analysis of Top Business and Application-Oriented AI Keywords for Each Technical Method

The strategic relevance of AI tools across a range of organizational operations is shown by their analysis in diverse technological disciplines. The primary ways that tailored AI applications improve automation, efficiency, and decision support in business operations are illustrated by key findings from Table C.3, "Top Business and Application-Oriented AI Keywords vs. Technical AI Methods with Respective Average Unique Numbers", see Appendix C.

In the Speech Recognition method, AI tools like chatbots, social robots, and collaborative robots highlight automation and customer support. While social robots enable human-robot interaction in client-facing settings, chatbots automate responses and enhance customer service. By reducing manual interventions and enabling hands-free, voice-controlled activities, collaborative robots in manufacturing improve operational efficiency.

Image Recognition keywords, including Social Robots, Surveillance Robotic Systems, and Collaborative Robots in Manufacturing, demonstrate the significance of visual processing of data for automation and monitoring. Social robots improve customer service engagement by responding to visual cues through their image recognition capabilities. While automated manufacturing and supply chain systems demonstrate the value of image recognition in lowering manufacturing and logistics failures, surveillance robotic systems use image recognition for security by identifying anomalies.

Machine learning's versatility across corporate operations is demonstrated by terminology like chatbots, recommender systems, and cyber threat intelligence. Cyber threat intelligence helps detect security threats, recommender systems improve personalization, and chatbots driven by machine learning increase customer engagement while cutting expenses. Through tools like Data Analytics for Manufacturing and Logistics Systems and Automated Manufacturing Systems, machine learning also improves production and logistics.

In Knowledge-Based Systems, organized knowledge application and decision support are highlighted with

keywords like Cyber Threat Intelligence, Business Process Management, and System Recovery. These technologies facilitate risk assessment, workflow optimization, and production process enhancement, demonstrating AI's contribution to operational robustness and human-robot interaction, particularly in industries like logistics and manufacturing.

There are three main themes that emerge from this survey question. First, AI's operational capability across a variety of functional domains, including logistics, security, and customer service, is demonstrated by its versatility across approaches, as evidenced by the widespread usage of cyber threat intelligence and data analytics. Second, the necessity for traceable and intelligible AI decision-making is emphasized by the emphasis on security and transparency through Explainable AI and Cyber Threat Intelligence. Lastly, the industry's push for AI-powered automation to boost productivity and competitiveness is shown by the focus on collaborative robots and automated systems in manufacturing and production. For further reference, Appendix C offers comprehensive keyword descriptions.

4.4.2 Survey Results Round 2: Analysis of Top 5 Technical AI Keywords for Business Department

The review of the most popular Technical AI keywords across business divisions demonstrates how AI methods are customized to fit certain organizational requirements, promoting innovation, decision-making, and operational effectiveness, see Table C.5 in Appendix C. The adaptability and applicability of different kinds of AI technologies across organizational functions is highlighted by this survey question.

In Marketing and Sales, keywords such as Support Vector Machines, Scene Understanding, and Image Motion Analysis show the focus on predictive analytics and visual data processing for improving customer segmentation and targeted advertising. Better consumer interaction and more tailor-made campaigns are made possible by these technologies.

For Research and Development (R&D), sophisticated techniques like Deep Learning Algorithms, Reinforcement Learning, and Gradient Tree Boosting highlight the vital function of machine learning in complicated data analysis and development of models. AI-driven innovation and scientific discovery are further strengthened by expert systems and support vector machines.

Manufacturing and Production departments adhere to automation and decision-making through Expert Systems, Rule-Based Systems, and Scene Understanding. These terms highlight how AI may improve industrial processes' accuracy and efficiency through quality control, workflow optimization, and predictive maintenance.

In Human Resources (HR), keywords like Image Motion Analysis, Deep Learning Algorithms, and Speech Synthesis point out AI's usefulness in talent management, candidate examination, and performance evaluation. A more effective and motivated staff is made possible by the use of expert systems and commonsense reasoning, which facilitate structured decision-making.

For Distribution and Logistics, AI-driven decision-making and supply chain optimization are given attention through technologies such as Expert Systems, Rule-Based Systems, and Reinforcement Learning. These methods simplify the logistics process by supporting inventory control, optimized routing, and real-time decision-making.

In Cybersecurity, Deep Learning Algorithms, Gradient Tree Boosting, and Expert Systems show AI's importance in early threat identification and adaptive reaction capacities. Real-time mitigation of threats is additionally made possible by reinforcement learning and commonsense reasoning, which also improve security procedures.

Once more, three major trends emerge from this specific survey question. First, expert systems' cross-departmental relevance shows how adaptable they are in supporting a range of business operations, from cybersecurity to consumer engagement. Second, the application of Support Vector Machines and Gradient Tree Boosting demonstrates how predictive analytics and data classification are essential for obtaining actionable insights in consumer behavior and danger identification. Finally, applications of Tailored AI, such as Reinforcement Learning in Cybersecurity and Speech Synthesis for HR engagement, demonstrate how AI may be tailored to certain departmental requirements.

This investigation shows how departments use AI to accomplish different objectives while utilizing common methods such as Gradient Tree Boosting and Expert Systems, which enhance organizational effectiveness and strategic decision-making. Organizations can gain a competitive edge, robustness, and agility by incorporating AI into a variety of operations. In order to maintain a clear focus on the core findings in the main text, all keyword information and examples have been transferred to Appendix C for reference.

4.4.3 Survey Results Round 2: Analysis of cross-tab of Technical AI Methods and Business Departments

Table C.6 in Appendix C presents the cross-tabulation of Business Departments and Technical AI Methods, highlighting how different AI methods are applied across organizational departments. This comparison reveals key patterns, showing that certain AI methods, like machine learning, are broadly applicable and flexible, supporting tasks across all departments, from cybersecurity to marketing. Machine learning's predictive capabilities and process automation benefits make it adaptable to diverse operational needs.

Speech recognition proves to be very useful in customer-focused fields like marketing and sales as well as human resources. With applications like chatbots in marketing or more efficient HR contacts, it improves communications, security, and consumer engagement. The fields of manufacturing, production, and cyber-security are where image recognition is most useful since it facilitates vital functions like quality control and surveillance monitoring. Knowledge-based systems are widely used in HR, distribution and logistics, and cyber-security to enhance knowledge management, risk reduction, and logistics decision-making.

According to the report, optimizing resource utilization is made possible by matching AI tactics to the unique requirements of each department, particularly for broadly applicable technologies like machine learning. Meanwhile, specialized AI solutions can be needed by departments with particular needs, such as cybersecurity. All things considered, a department-wide coordinated AI approach improves operational effectiveness and competitiveness, allowing businesses to strategically and successfully utilize AI investments. Detailed examples of the use of speech recognition for onboarding in HR and the use of image recognition for quality control in manufacturing can be found in Appendix C.

4.5 Survey Results Round 1 & 2: Analysis of Strategic AI Integration Across Business Departments: Insights from Table C.7

The survey results presented in Table C.7 shows how Business AI tools are strategically integrated with specific AI technologies. Organizations can customize AI applications for optimum performance by utilizing a combination of technical and business AI tools tailored to each business area's unique operating requirements.

Business Department	Technical AI Keywords	Business AI Keywords
Marketing/Sales	Support vector machines	Recommender Systems
	Scene understanding	Customer relationship management
	Image motion analysis	Chatbots
Research & Development (R&D)	Reinforcement learning	Virtual prototyping
	Deep Learning Algorithms	Explainable AI
	Expert system	Digital twins
Manufacturing and Production	Expert system	Automated Manufacturing Systems
	Rule-based systems	Collaborative Robots in Manufacturing
	Scene understanding	Data Analytics for Manufacturing and Logistics
		Systems
Human Resources	Image motion analysis	Human Performance Augmentation
	Deep Learning Algorithms	Social robots
	Speech synthesis	Business process management
Distribution and Logistics	Expert system	Automated Supply Chain Systems
	Rule-based systems	Data Analytics for Manufacturing and Logistics Systems
	Reinforcement learning	Business process management
Cyber-Security	Gradient tree boosting	Cyber threat intelligence
	Deep Learning Algorithms	System recovery
	Expert system	Surveillance Robotic Systems

Table C.7: Top 3 Technical AI & Business AI Keywords for Each Respective Business Department

In Marketing and Sales, tools like Support Vector Machines and Scene Understanding promote client analysis and involvement via personalized advertising and customer insights. These techniques improve customer happiness and communication when paired with corporate AI tools like chatbots and CRM.

For Research and Development (R&D), sophisticated machine learning techniques, including Reinforcement Learning and Deep Learning, enable complicated analysis and experimenting, while Expert Systems support testing of hypotheses. These resources, when combined with business tools like explainable AI and digital twins, provide an imaginative R&D environment that speeds up product development.

Manufacturing and Production profit from Expert Systems and Rule-Based Systems for quality control and automation. Continuous surveillance is made possible by Scene Understanding, and commercial AI solutions such as automated manufacturing systems improve productivity and streamline processes.

In Human Resources, Speech Synthesis, Deep Learning, and Image Motion Analysis strengthen talent management and training procedures. These AI solutions, which are backed by business tools such as business process management, establish a data-driven human resources environment that boosts worker happiness and productivity.

For Distribution and Logistics, Expert Systems, Rule-Based Systems, and Reinforcement Learning maximize the administration of logistics and flexible decision-making. Automated supply chain systems and other business AI solutions enhance operational effectiveness in shipping and inventory control.

In Cybersecurity, machine learning-based techniques like Gradient Tree Boosting and Deep Learning Algorithms facilitate active threat monitoring. These techniques reinforce both physical and online safety procedures and are backed by business AI technologies for threat intelligence and monitoring.

All things considered, Table C.7's results show that combining technical AI with business and application-oriented tools improves resilience and decision-making across departments. Organizations can adopt a complete, AI-driven strategy that supports growth in a variety of domains, from cybersecurity to customer interaction, by coordinating AI applications with departmental objectives. Appendix C now contains details on how each AI tool works, such as how scene understanding allows for real-time quality assessment.

5 DISCUSSION

5.1 Summary of Key Findings

As indicated in Table C.8 in Appendix C, the cross-tab examination of Technical Methods, Technical AI algorithms, and Business AI applications across business departments demonstrates unique patterns of AI deployment catered to the goals of each department. Four major topics have been identified.

From proactive threat identification in cybersecurity to customer segmentation in marketing and sales, machine learning's versatility is apparent across all departments. Because of its adaptability, machine learning is positioned as a cross-functional technology that is necessary for scalable, data-driven insights that improve operational effectiveness and customer engagement.

Automation and quality control are emphasized in Manufacturing, Production, Distribution, and Logistics, where Expert Systems and Rule-Based Systems help reduce human intervention. In Manufacturing, these tools streamline production processes, while in Logistics, they support inventory control and route optimization, thus reinforcing operational resilience and cost-effectiveness across the supply chain.

Interaction and involvement are given top priority by departments that deal with consumer and employee interaction, such as marketing, sales, and human resources. When paired with business AI tools like chatbots and CRM, technical AI capabilities like speech and image recognition improve real-time interactions and establish a data-driven HR environment that promotes employee happiness and productivity.

Finally, for resilience and proactive threat management, cybersecurity makes use of knowledge-based systems and machine learning. By enabling real-time monitoring and decision-making, algorithms such as Gradient Tree Boosting and Deep Learning, in conjunction with Cyber Threat Intelligence and Surveillance Robotics, provide threat identification, reaction, and asset protection.

In conclusion, a coherent paradigm for the strategic deployment of AI is shown in Table C.8. The results demonstrate that although many AI techniques, like machine learning, are widely applicable, others, like speech and picture recognition, are customized to meet the demands of particular departments. Organizations may build an adaptable, effective infrastructure that optimizes the impact of AI investments across functions by coordinating AI with departmental goals. Specific descriptions of AI applications in each department such as that Support Vector Machines create a database for customer segmentation, are moved to Appendix C to maintain focus on overarching themes.

5.2 Comparisons to Existing Literature

Comparing the results with previous research on AI adoption across business functions is crucial to placing this study in the larger framework of AI research. Several studies have looked at how AI technologies—in particular, machine learning—are used in a variety of industries to boost innovation, improve efficiency, and streamline procedures.

This paradigm change away from traditional centralized applications for production control has a substantial influence on industrial systems in the context of the Industry 4.0 revolution. According to Almada-Lobo (2015), Industry 4.0 aims to create a decentralized network of smart factories with intelligent, self-governing shop floor entities that directly address consumer needs for customized goods.

This shift is made possible by cutting-edge technologies such as big data, cloud computing, mobile devices, 3D printing, and the Internet of Things (IoT), which together create a completely new manufacturing environment. In order to support the dynamic and decentralized nature of contemporary manufacturing processes, future manufacturing execution systems (MES) must adjust to this change (Almada-Lobo, 2015).

These advancements are consistent with the current study's conclusions, which emphasize machine learning as a vital instrument for promoting flexibility and effectiveness in the production and manufacturing divisions. This link emphasizes AI's wider applicability in facilitating the shift to more adaptable, technologically advanced manufacturing systems.

The use of machine learning to increase productivity is one recurring theme in the literature. The ability of machine learning to help decision-making, identify

patterns, and perform predictive analytics has been shown in previous research. In a similar vein, this study discovered that machine learning is extremely applicable in a variety of fields, such as manufacturing and production, cybersecurity, and research and development, where it facilitates applications ranging from threat identification to predictive maintenance. Notably, machine learning has proven to be quite helpful in manufacturing and production for process optimization and defect detection. Chiu, Tsai, and Li (2020), for instance, suggest an integrative machine learning technique that sets off a defect detection warning long before a machine malfunctions, enabling shop-floor engineers to modify its settings or carry out maintenance to lessen the effects of its shutdown. This proactive strategy improves operational stability and productivity, highlighting the importance of machine learning in preserving dependable and effective systems in industrial contexts (Chiu, Tsai, & Li, 2020). This study supports existing research on the adaptability and broad applicability of machine learning in commercial settings by validating these findings.

The literature also often discusses knowledge-based systems as useful instruments for decision support, especially in complicated settings. The results of this study also demonstrate the importance of knowledge-based systems in divisions such as cyber-security, distribution and logistics, and human resources. AI's significance in human resources, particularly in the hiring process, has drawn more attention. Information security and return on investment are two important considerations for HR managers when thinking about implementing AI in hiring, according to Bhatt (2023). According to research, artificial intelligence (AI) is especially well-suited for jobs like sourcing and preliminary screening, where it can improve security and efficiency when managing sensitive candidate data (Bhatt, 2023).

These observations highlight the value of knowledge-based systems in human resources since they facilitate decision-making, guarantee adherence to security procedures, and enhance resource management in general. These results and the current study's alignment highlight AI's potential in HR to streamline talent acquisition procedures, hence bolstering AI's cross-functional applicability across various business divisions.

Knowledge-Based Systems are described in the literature as a means of capturing and utilizing expert knowledge, which can improve organizational efficiency, streamline processes, and improve decision-making. The alignment of knowledge-based systems with these particular functions in this study indicates that these systems will continue to be relevant in supporting business choices, as evidenced by their demonstrated utility in previous studies. For example, Moskal (2016) presents a knowledge-based decision-making model for modeling the actions of cyberattacks. This model combines an assemblage of attacker capabilities, opportunities, intent, and preferences with the Cyber Attack Kill Chain. The model enables the simulation of different network attack behaviors and their consequences by offering user-configurable choices (Moskal, 2016).

The results of this study are further supported by this framework for cyber-security decision-making, which shows that knowledge-based systems are widely used in divisions such as cyber-security. These systems' potential to improve security measures inside businesses is shown in their capacity to mimic, foresee, and react to complex attacks. As a result, knowledge-based systems are relevant not only for operational decision-making but also for predictive and preventive security, which emphasizes their crucial role in a variety of corporate operations.

Additionally, this study shows a strong correlation between image recognition, cyber-security, and manufacturing & production. Image recognition is frequently discussed in existing research in terms of security monitoring and quality control, with a focus on how it may automate visual inspection and improve surveillance capabilities. This concerns techniques such as Surveillance Robotic Systems, Scene anomaly and Image motion analysis, for cyber-security, and Collaborative Robots in Manufacturing and Automated Manufacturing Systems for Manufacturing and production. Various results in the literature consistently highlight the increasing significance of visual data processing in various fields and imply that businesses should keep using image recognition to increase operational safety and accuracy. Zhang et al. (2020), for instance, emphasize how image recognition algorithms can be integrated with network security visualization technologies. High-accuracy feature point extraction is made possible by this fusion, increasing detection rates and reducing false alarms. Their research contributes to the use of image recognition for network security by offering an efficient technique for data security visualization (Zhang et al., 2020).

This demonstrates the value of image recognition in operational and security settings, where processing visual data improves monitoring and security protocols while also assisting with quality control. Organizations may demonstrate the many advantages of image recognition across industries by combining these technologies to increase the precision of visual inspections and the resilience of their security systems.

There are chances for more research in areas where the results deviate from the body of current literature. For instance, this study revealed less attention on AI in marketing and sales than in other departments, despite

the fact that many studies highlight this field for customer analysis and tailored marketing. This discrepancy might be an indication of how companies' priorities are changing, with a growing emphasis on operational security and efficiency when investing in AI. On the other hand, it might indicate that further research is necessary to determine why Marketing and Sales are not utilizing AI to the degree that other studies have shown, possibly because of obstacles like cost, data accessibility, or implementation complexity.

According to research by Kedi et al. (2024), AI software has a significant impact on small and medium-sized enterprises' (SMEs) tailored marketing automation, especially when it comes to improving customer experience and increasing sales. Businesses may now offer highly tailored information and recommendations thanks to artificial intelligence (AI) technology like machine learning, natural language processing, and predictive analytics. This greatly increases customer engagement and retention. Higher conversion rates, lower customer acquisition costs, and greater client lifetime value are the outcomes of SMEs' increased marketing operations' efficiency and scalability thanks to AI integration. According to Kedi et al. (2024), successful case studies from a variety of industries demonstrate how the application of AI-driven marketing tactics has resulted in notable gains in sales performance and return on investment.

There may be a discrepancy between the theoretical advantages of AI in personalized marketing and its actual implementation in practice, as evidenced by the findings of this study and those of Kedi et al., which show a lower prioritizing of AI in marketing and sales. This discrepancy may suggest a lack of awareness of AI's full potential in customer-centric domains or it may highlight particular difficulties SMEs or larger enterprises encounter when using AI in marketing tasks. More research into this discrepancy may shed light on the obstacles preventing AI from being widely used in marketing and sales as well as how companies may get beyond them to fully utilize AI's potential to increase consumer engagement and sales.

By making these comparisons, this study adds to the continuing conversation about the adoption of AI in business operations by highlighting subtleties and new trends in addition to confirming the current usefulness of AI in well-established fields. Future research that aims to elaborate on how AI technologies continue to develop and affect organizations in many industries can benefit from these findings. In the end, comparing the results to previous studies confirms the validity of the findings and highlights the study's significance in relation to the larger field of AI research.

5.3 Limitations

Although this study offers valuable insights into the adoption of AI and the applicability of AI keywords across a range of business areas, it is important to recognize a number of limitations that could affect the findings' robustness and generalizability. These restrictions, which are divided into methodological and general study limitations, point to areas that require more investigation and verification.

Despite efforts to assure informed expert participation through purposeful sampling, the small sample size is a significant constraint that may limit the findings' wider applicability. A bigger sample size could improve the results' generalizability and offer a more thorough understanding of AI's influence across industries, even if this method collected a variety of viewpoints from informed people. This restriction implies that in order to improve the validity and relevance of the results, future research should think about increasing the sample size.

Apart from sampling limitations, certain biases associated with AI-driven tools are introduced by the first usage of ChatGPT for keyword categorization. Although ChatGPT offered a quick and effective way to identify keywords, its machine-driven classifications could not have the sophisticated comprehension needed to completely capture contextual nuances and domain-specific terminology. By depending too much on AI classification, biases may be unintentionally introduced, thereby distorting keyword relevance and classification according to algorithmic interpretations rather than expert-driven insights. By integrating expert verification with AI-based categorization, future research could reduce this risk and guarantee that the chosen keywords appropriately represent specialized terminology in a variety of commercial situations. Choosing which features to include in the model is a crucial part of machine learning, and if some features are over- or under-represented, the results may be skewed.

This study's mixed-methods approach has methodological drawbacks as well. In order to give a comprehensive picture of AI's suitability for various business operations, the study will combine quantitative evaluations with qualitative comments. However, because the categories were determined by experts who are susceptible to personal interpretations and past experiences, the cross-tabulation of Technical AI and Business AI keywords may introduce inherent biases. Respondents' occupational backgrounds and experience to particular AI technologies probably influenced their answers, as they were asked to rank the significance of different keywords. Experts in manufacturing and production, for example, would give priority to automation technology, whereas cybersecurity specialists might give greater weight to threat detection techniques.

Individual experiences can affect the perceived relevance of various AI techniques, resulting in an unintentional weighting of some terms over others. These biases are inherent in survey-based research. In order to lessen reliance on subjective evaluations, future research might acknowledge this constraint and include a larger variety of expert profiles or validate findings using observational or empirical data.

The study's dependence on keyword-based cross-tabulation, which might not fully capture the complexity of AI applications, results in theoretical and analytical constraints. The trade-off between utilizing specific versus broad AI terminology limits the cross-tabulation approach. While specialized keywords offer nuanced viewpoints but run the danger of over-representing certain applications or business activities, general keywords offer broad insights into AI applications but may lack depth. It is still difficult to strike a balance between comprehensiveness and specificity because doing so could cause some AI applications in commercial environments to be overemphasized or underemphasized. In order to produce a more accurate depiction of AI applications across domains, future research could investigate dynamic keyword frameworks that strike a compromise between these criteria.

In conclusion, this study emphasizes the significance of controlling potential biases and methodological limitations even if it provides an organized strategy for comprehending AI usefulness and alignment with business tasks. The findings' relevance would be further strengthened by addressing these constraints through larger sample numbers, better keyword validation, varied expert input, and model-based testing. Future studies that take these improvements into account will help create more precise lists of AI keywords, enabling more focused and nuanced adoption strategies that support organizational goals.

6. CONCLUSION

In conclusion, the study highlights the significance of striking a balance between comprehensiveness and specificity in order to limit potential biases, even though it also offers insightful information about AI keyword relevance and business function alignment.

The main conclusions could not be drawn through each table individually and by stating the direct results but only by seeing the larger pattern that all the combined results of the cross-tabs suggest. These common tendencies across the different cross-tabs can be concluded from the visualized Table C.9., ‘’All cross-tabulations conducted in the survey round 1 and 2’’, see appendix C. The adaptability of machine learning, which became a useful tool for all corporate divisions, including manufacturing and production, cybersecurity, and research and development (R&D), is one of the analysis's main conclusions. Its steady presence in all of these roles suggests how useful it is for promoting predictive analytics and data-driven decision-making. This wide range of applications suggests that businesses can gain from incorporating machine learning into a number of procedures, including detecting security risks, improving creativity, and doing predictive maintenance.

On the other hand, decision-making processes were often linked to knowledge-based systems, especially in the area of distribution and logistics In order to improve operational efficiency, this highlights the significance of AI systems that can handle, process, and use expert systems. Businesses are increasingly depending on artificial intelligence (AI) to handle complicated workflows and optimize supply chains as seen by the widespread use of KBS in logistical situations such as with Expert systems, Business process management and Commonsense reasoning.

In departments that interact with customers, such as marketing and sales, speech recognition is essential. It has been useful for improving customer engagement, automating interactions, and assisting with employee training when implemented through chatbots and other speech-driven technologies like Social robots. However, compared to machine learning, which has a larger range of applications, its usefulness is more specialized.

In manufacturing and logistics, where visual data processing is essential for automating quality control, detecting flaws, and keeping an eye on supply chains, image recognition was particularly important. These departments' use of image recognition is indicative of its contribution to increased operational effectiveness and surveillance capabilities, through technologies such as Scene understanding and Automated Manufacturing Systems.

In conclusion, the study's conclusions show that businesses typically implement AI technologies in ways that closely match the requirements of their particular departments. Some technologies—like machine learning and knowledge-based systems—have a wide range of applications, but others—like speech recognition and image recognition—have more specialized applications, especially in tasks that involve interacting with customers or security. These observations advance knowledge of AI adoption in business and emphasize how crucial it is to match departmental goals with AI initiatives.

6.1 Recommendations for Business AI Strategy

Several suggestions for companies looking to create or improve their AI strategy can be made in light of the findings. Because of its adaptability and ability to improve predictive analytics and decision-making processes, machine learning ought to be given top priority across departments. Businesses may increase everything from manufacturing efficiency to cyber-security resilience by investing in machine learning.

In divisions where organized decision-making procedures are necessary, such as distribution and logistics, R&D, and HR, businesses should also concentrate on knowledge-based systems. This is especially pertinent to distribution and logistics where efficient decision-making and workflow management are critical. Because of their ability to facilitate strategic decision-making and efficient operations, knowledge-based system technologies—such as Human Performance Augmentation and Commonsense reasoning for HR, Business Process Management, and Expert systems for R&D—have also become indispensable in these divisions.

It is advised that businesses with a significant emphasis on customer service such as marketing and sales, use speech recognition technologies, such as chatbots, Social robots or Customer relationship management. These solutions have proven to be successful in raising customer satisfaction levels, cutting expenses, and improving consumer engagement in general.

Investing in image recognition can greatly enhance automation and quality control procedures in manufacturing and logistics. Reduced human error and improved manufacturing quality can result from image recognition's effective processing and analysis of visual input. These improvements could be realized by investing in Collaborative Robots in Manufacturing and Automated Manufacturing Systems for Manufacturing and production. Also, cyber-security can highly benefit from investments in image recognition technologies in terms of security monitoring and quality control, with a focus on how it may automate visual inspection and improve surveillance capabilities. This concerns techniques such as Surveillance Robotic Systems, Scene anomaly and Image motion analysis, for cyber-security

Lastly, implement a flexible AI strategy that evaluates each department's technological fit on a frequent basis. This study shows that while some AI technologies, like Knowledge-based systems and machine learning, may be used for a wide range of tasks, others, like image and speech recognition, are more specialized. Businesses can make sure that their AI investments stay impactful, relevant, and able to change with organizational needs by putting in place a framework for continuous evaluation and realignment of AI applications with departmental goals.

6.2 Suggestions for Future Research

The present study emphasizes the necessity of further investigation to enhance our comprehension of the alignment of AI technology across business processes and the mitigation of biases in the selection of AI keywords. Growing research on AI technology applications and keyword validation is crucial for improving how companies can use AI more successfully as organizations depend more and more on it. The recommendations that follow offer a targeted road map for the next studies in this field.

First, use model-based validation to broaden the investigation of AI keyword efficacy. Future research might use models like a BERT model to quantitatively evaluate the relevance and usefulness of keywords across a variety of business applications, even though this study assessed keyword lists within the larger framework of business functions. This method would assist in figuring out whether certain AI keywords are consistently relevant or whether departmental variances exist. The biases found in this study can be addressed by researchers by broadening model-based validation to create keyword lists that are thorough, devoid of needless overlaps, and tailored to departmental requirements.

Second, look at long-term research on the patterns of AI adoption in various commercial domains. Given the expanding significance of AI technologies, longitudinal research may show how the use of particular AI methods—like knowledge-based systems or machine learning—changes over time across various industries and corporate divisions. As this study emphasizes, such research would be useful in monitoring the development of machine learning's adaptability and knowledge-based systems' emphasis on distribution and logistics. An ongoing analysis of the use of these technologies may shed light on their long-term effects, efficacy, and potential for corporate strategy modifications.

Examine the possibility of department-specific AI taxonomies as well. The usefulness of creating AI taxonomies suited to certain departmental requirements is suggested by this study, which shows that AI technologies have differing degrees of alignment with various business tasks. For example, manufacturing taxonomies might emphasize image recognition and automated inspection systems, whereas customer-facing taxonomies might emphasize chatbots and speech recognition. The creation of these taxonomies would facilitate the rapid identification of appropriate AI

solutions by organizations, accelerating the adoption of AI in a way that is functionally useful.

Additionally, look into how employee performance and AI-enabled products interact. Future studies should examine the effects of more specialized technology like picture and speech recognition on worker happiness and productivity across departments. Comprehending these dynamics might help determine the best way to apply AI technologies, especially for jobs like quality control and customer support that necessitate regular staff engagement.

Comparative cross-sectoral studies that look at AI's function in a variety of industries, including manufacturing, banking, and healthcare, may potentially provide important insights into industry-specific AI programs. Businesses may be better able to comprehend how AI might be customized to satisfy certain industry demands if comparative research reveals both common AI uses and sector-specific subtleties. Additionally, future studies should evaluate how well AI supports these developing fields as the spectrum of corporate tasks keeps growing, especially with the emergence of positions centered on sustainability and digital transformation. As businesses adjust to changing possibilities and challenges, it will be critical to look into how AI supports newer positions within organizations. This will enable them to use AI more strategically across a wider range of roles.

Furthermore, a targeted research program is necessary to address biases in AI applications. The limitations of this study show how biases can affect keyword categorization and relevance. These biases can be introduced by sampling, AI-driven technologies, and human interpretation. Future studies could examine these biases in further detail, including how much specific keywords or applications may be overrepresented or underrepresented in algorithmic classifications. These biases might be lessened by creating a hybrid strategy that blends AI classification with expert oversight, enabling a balance between human judgment and machine efficiency. In order to prevent biased applications that can misalign AI investments with real departmental needs, it is crucial to recognize and address biases as AI's involvement in decision-making grows. Reducing subjectivity may also be facilitated by increasing sample sizes and including a wider variety of expert profiles, guaranteeing that AI-driven keywords and applications represent the entire spectrum of business scenarios.

Lastly, create methods for evaluating AI's contribution to cross-functional integration. An increasing number of company operations rely on interconnected processes, where AI facilitates cross-departmental decision-making. Investigating approaches that assess AI's function in these cross-functional situations will improve knowledge of how machine learning and other technologies may close gaps between cybersecurity, logistics, and production. Future studies could pinpoint best practices for developing unified, AI-driven plans that align departmental objectives by concentrating on cross-functional integration.

These recommendations are meant to further the fundamental understanding of this research by giving future scholars certain directions to pursue. Future research can improve the applicability, efficacy, and alignment of AI technologies in a variety of business contexts by concentrating on model-based validation, longitudinal analysis, department-specific taxonomies, employee impact, cross-sectoral insights, bias mitigation, and cross-functional integration.

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8. APPENDICES

8.1 Additional Tables or Figures

8.1.1 Appendix S: Theoretical Framework and Pre-validated Thesaurus

Technical AI Category	Technical AI Keywords
Speech Recognition	1. Speech synthesis (Ieee, n.d.)
	2. Sentiment analysis (Ieee, n.d.)
	3. Natural Language Processing (PATENTSCOPE artificial intelligence index, n.d.)
	4. Stemming (PATENTSCOPE artificial intelligence index, n.d.)
	5. Lemmatization (PATENTSCOPE artificial intelligence index, n.d.)
	6. Named entity recognition (Ieee, n.d.)
	7. Phonetics (Ieee, n.d.)
Image Recognition	1. Facial recognition (PATENTSCOPE artificial intelligence index, n.d.)
	2. Saliency detection (Ieee, n.d.)
	3. Convolutional neural networks (Ieee, n.d.)
	4. Scene understanding (PATENTSCOPE artificial intelligence index, n.d.)
	5. Feature extraction (Ieee, n.d.)
	6. Scene anomaly detection (PATENTSCOPE artificial intelligence index, n.d.)
	7. Image motion analysis (Ieee, n.d.)
Machine Learning	1. Few-shot learning (Ieee, n.d.)
	2. Semisupervised learning (Ieee, n.d.)
	3. Reinforcement learning (PATENTSCOPE artificial intelligence index, n.d.)
	4. Deep Learning Algorithms (AAAI-24 keywords, 2023)
	5. Rule-based systems (Ieee, n.d.)
	6. Support vector machines (Ieee, n.d.)
	7. Gradient tree boosting (PATENTSCOPE artificial intelligence index, n.d.)
	8. Feedforward neural networks (Ieee, n.d.)
Knowledge-Based Systems	1. Inductive Logic Programming (Elsevier)
	2. Generative adversarial networks (Ieee, n.d.)
	3. Commonsense reasoning (Ieee, n.d.)
	4. Bayesian network (PATENTSCOPE artificial intelligence index, n.d.)
	5. Process mining (Ieee, n.d.)
	6. Control systems (Ieee, n.d.)
	7. Expert system (PATENTSCOPE artificial intelligence index, n.d.)
	8. Deep Generative Models (Ieee, n.d.)

Table S.1. Technical AI Keywords Categorized in Technical AI Methods with sources

Business Department	Business AI Keywords
Marketing/Sales	1. Chatbots (PATENTSCOPE artificial intelligence index, n.d.)
	2. Personal voice assistants (Ieee, n.d.)
	3. Recommender Systems (AAAI-24 keywords, 2023)
	4. Customer relationship management (Ieee, n.d.)
	5. Image tagging (Ieee, n.d.)
Research & Development (R&D)	1. Virtual prototyping (Ieee, n.d.)
	2. Digital twins (Ieee, n.d.)
	3. Developmental Robotics (IEEE Robotics and Automation Society, 2024)
	4. Explainable AI (Ieee, n.d.)
	5. Cognitive Robotics (AAAI-24 keywords, 2023)
Manufacturing and Production:	1. Automated Manufacturing Systems (IEEE Robotics and Automation Society, 2024)
	2. Collaborative Robots in Manufacturing (IEEE Robotics and Automation Society, 2024)
	3. Cyber-physical Production Systems and Industry 4.0 (IEEE Robotics and Automation Society, 2024)
	4. Manufacturing, Maintenance and Supply Chains (IEEE Robotics and Automation Society, 2024)
	5. Control Systems (Ieee, n.d.)
Human Resources	1. Human-robot interaction (Ieee, n.d.)
	2. Virtual Assistant (Ieee, n.d.)
	3. Social robots (Ieee, n.d.)
	4. Human Performance Augmentation (Ieee, n.d.)
	5. Affective computing (Ieee, n.d.)
Distribution and Logistics	1. Automated Supply Chain Systems (IEEE Robotics and Automation Society, 2024)
	2. Power distribution planning (Ieee, n.d.)
	3. Robot vision systems (Ieee, n.d.)
	4. Data Analytics for Manufacturing and Logistics Systems (IEEE Robotics and Automation Society, 2024)
	5. Business process management (Ieee, n.d.)
Cyber-Security	1. Surveillance Robotic Systems (IEEE Robotics and Automation Society, 2024)
	2. Concurrency control (Ieee, n.d.)
	3. Cyber threat intelligence (Ieee, n.d.)
	4. Failure Detection and Recovery (IEEE Robotics and Automation Society, 2024)
	5. System recovery (Ieee, n.d.)

Table S.2. Business and application-oriented AI Keywords Categorized in Business Departments with Sources

8.2 Survey Instrument

8.2.1 Appendix A: Survey Round 1 Original AI Keyword Lists for Validation and Categorization

Survey Process:

Question 1:

For the Technical AI Keyword List:

1. Rate each keyword according to how well it fits within its corresponding Technical Method on a scale from 0 to 2.
   - Scale: 0 (No Fit), 1 (Moderate Fit), 2 (Strong Fit)
2. Categorize each keyword under one of the following Technical Methods:
   - Understanding of Speech
   - Image Recognition
   - Machine Learning
   - Knowledge-Based Systems

Question 2:

For the Business and Application-Oriented AI Keyword List:

1. Rate each keyword based on how well it aligns with a specific Business Department on the same 0 to 2 scale:
   - Scale: 0 (No Fit), 1 (Moderate Fit), 2 (Strong Fit)
2. Categorize each keyword into one of the following Business Departments:
   - Marketing/Sales
   - Research & Development (R&D)
   - Manufacturing and Production
   - Human Resources
   - Distribution and Logistics
   - Cyber-Security

For the Qualitative questions:

Question 3:

Instructions for Use:

- Respondents should mark the column that best describes their level of AI usage for each Business Department.
- Not used indicates no usage of AI techniques or systems in that department.
- Slightly Used suggests occasional or minimal usage.
- Heavily used signifies significant and frequent usage of AI within that business department.

Scale:

- 1: Not Used
- 2: Slightly Used
- 3: Heavily Used

Question 4:

What specific techniques or systems do you use that incorporate or relate to Artificial Intelligence? Please describe the AI methods, tools, or systems you apply in your work.

Question 1:
Technical AI Keyword Fit and Categorization

Please evaluate the relevance of each Technical AI Keyword within the corresponding Technical Method. For each keyword, provide a rating based on how well it fits the specific method. Additionally, categorize each keyword into the most appropriate Technical Method.

Rating Scale:

0: No Fit
1: Weak Fit
2: Strong Fit

Categorization:

Categorize each keyword by selecting the most suitable Technical Method. If no rating is provided for a specific method, it will be considered as No Fit for that method.

Technical Methods:

Understanding of Speech
Image Recognition
Machine Learning
Knowledge-Based Systems

Technical AI Keywords	Understanding of Speech	Image Recognition	Machine Learning	Knowledge-Based Systems
Convolutional neural networks				
Named entity recognition				
Bayesian network				
Feature extraction				
Stemming				
Process mining				
Rule-based systems				
Phonetics				
Gradient tree boosting				
Semisupervised learning				
Generative adversarial networks				
Deep Learning Algorithms				
Few-shot learning				
Commonsense reasoning				
Reinforcement learning				
Scene understanding				
Saliency detection				
Deep Generative Models				
Speech synthesis				
Control systems				
Scene anomaly detection				

Inductive Logic Programming				
Natural Language Processing				
Sentiment analysis				
Facial recognition				
Support vector machines				
Feedforward neural networks				
Expert system				
Image motion analysis				
Lemmatization				

Table A.1. Table for Question Technical AI Keywords categorized by Technical AI Method

Technical AI Category	Technical AI Keywords	Respective average unique numbers ranked
Speech Recognition	Phonetics	1.583803333
	Speech synthesis	1.417576667
	Deep Learning Algorithms	1.417296667
Image Recognition	Image motion analysis	2.00132
	Facial recognition	1.75116
	Scene understanding	1.667466667
Machine Learning	Support vector machines	2.00121
	Reinforcement learning	1.75077
	Semisupervised learning	1.75053
Knowledge-Based Systems	Rule-based systems	1.50046
	Expert system	1.417966667
	Commonsense reasoning	1.334073333

Table A.2. Top 3 Technical AI Keywords categorized by Technical AI Method with ranked average score

As shown in Table A.2. ‘’Top 3 Technical AI Keywords categorized by Technical AI Method with ranked average score’’ in Appendix A, the first survey round's classification of Technical AI keywords produced a targeted selection of top keywords across four different Technical AI methods. These keywords were selected based on respondents' ratings of their applicability to particular technological techniques. The study sheds light on the most important AI technologies applied in various fields by determining the top three keywords for each approach. The lists of categories show the wide range of technologies that are compatible with Knowledge-Based Systems, Speech Recognition, Image Recognition, and Machine Learning.

The top three keywords for Speech Recognition were Deep Learning Algorithms, Speech Synthesis, and Phonetics. These keywords demonstrate a focus on both fundamental aspects of speech processing and cutting-edge AI techniques. The study of human voice sounds, or phonetics, is essential to precise speech recognition. This is complemented by speech synthesis, which aims to produce speech that is similar to that of a person, demonstrating the two-way nature of AI in this area—both

speech understanding and speech production. Deep Learning Algorithms' inclusion highlights how advanced neural network techniques are helping to improve speech recognition skills.

The terms image motion analysis, face recognition, and scene understanding were emphasized as the best options under the category of image recognition. The increasing intricacy of picture recognition challenges is reflected in this collection. Applications like video analysis and tracking depend on the movement of visual data, which is addressed by image motion analysis. One well-known AI application with broad applications, especially in security and identity, is facial recognition. Scene understanding highlights the drive for comprehensive image interpretation by going beyond item recognition to understand larger visual contexts.

Support vector machines, reinforcement learning, and gradient tree boosting were found to be the most popular keywords in the Machine Learning category. These selections demonstrate a fusion of state-of-the-art methods with traditional machine learning methodologies. Support vector machines are still often employed for classification problems, but reinforcement learning has become more popular because of its usage in autonomous systems and sequential decision-making. The effectiveness of gradient tree boosting in prediction tasks is acknowledged, which further demonstrates the wide range of machine learning tools at one's disposal.

Last but not least, knowledge-based systems include commonsense reasoning, expert systems, and rule-based systems. These choices demonstrate the continued applicability of structured AI techniques in intricate decision-making settings. Knowledge representation and automated reasoning are made easier by rule-based and expert systems, which are crucial in fields that demand a high degree of accuracy and transparency. This category is completed by commonsense reasoning, which shows attempts to give machines the ability to draw conclusions intuitively—a crucial component of human-like comprehension.

Question 2:

Business AI Keyword Fit and Categorization

Please rate how well each Business and Application-Oriented AI Keyword aligns with the specific Business Department. For each keyword, provide a rating based on its relevance to the particular department. Then, categorize the keyword into the most appropriate Business Department.

Rating Scale:

0: No Fit
1: Weak Fit
2: Strong Fit

Categorization:

Assign each keyword to the most appropriate Business Department. If no rating is provided for a particular department, it will be considered as No Fit for that department.

Business Departments:

Marketing/Sales
R&D
Manufacturing and Production
Human Resources
Distribution and Logistics
Cyber-Security

Business and Application-Oriented AI Keywords	Marketing/Sales	R&D	Manufacturing and Production	Human Resources	Distribution and Logistics	Cyber-Security
Social robots						
Control Systems						
Image tagging						

Cyber-physical Production Systems and Industry 4.0						
Recommender Systems						
Cognitive Robotics						
Virtual prototyping						
Business process management						
Cyber threat intelligence						
Failure Detection and Recovery						
Data Analytics for Manufacturing and Logistics Systems						
Collaborative Robots in Manufacturing						
Surveillance Robotic Systems						
Virtual Assistant						
Chatbots						
Power distribution planning						
Automated Manufacturing Systems						
Human-robot interaction						
Developmental Robotics						
Explainable AI						
Personal voice assistants						
Affective computing						
Automated Supply Chain Systems						
System recovery						
Manufacturing, Maintenance and Supply Chains						

Human Performance Augmentation						
Customer relationship management						
Digital twins						
Robot vision systems						
Concurrency control						

Table A.3. Table for Question Business and Application-Oriented AI Keywords categorized by Business Department

Business Department	Business AI Keywords	Respective average unique numbers ranked
Marketing/Sales	Recommender Systems	1.668326667
	Customer relationship management	1.50298
	Chatbots	1.418926667
Research & Development (R&D)	Virtual prototyping	1.25179
	Explainable AI	1.169236667
	Digital twins	0.919716667
Manufacturing and Production	Automated Manufacturing Systems	1.669066667
	Collaborative Robots in Manufacturing	1.668766667
	Data Analytics for Manufacturing and Logistics Systems	1.50204
Human Resources	Human Performance Augmentation	1.336283333
	Social robots	1.084783333
	Business process management	0.924946923
Distribution and Logistics	Automated Supply Chain Systems	1.50278
	Data Analytics for Manufacturing and Logistics Systems	1.50206
	Business process management	1.25188
Cyber-Security	Cyber threat intelligence	1.668616667
	System recovery	1.233619231
	Surveillance Robotic Systems	0.835523333

Table A.4. Top 3 Business and Application-Oriented AI Keywords categorized by Business Department with ranked average score

The Top 3 Business and Application-Oriented AI Keywords categorized by Business Department with ranked average score, can bee seen in Table A.4. of Appendix A and reflects the strategic integration of AI across many organizational domains. This list focuses on the real-world uses of AI technology in several business divisions, showing how AI is applied to meet various functional requirements.

Customer relationship management, chatbots, and recommender systems are the top three terms found in the marketing/sales division. These technological advancements demonstrate how AI may improve customer interaction and personalization. Recommender systems are frequently used to personalize content or product recommendations for specific users, boosting engagement and consumer satisfaction. While chatbots provide real-time customer care, increasing speed and efficiency in answering questions, customer relationship management uses AI to better understand consumer needs and optimize interactions.

The most pertinent keywords in Research & Development (R&D) are digital twins, explainable AI, and virtual prototyping. These tools are crucial for encouraging creativity and enhancing openness in AI applications. By simulating and testing goods prior to real production, virtual prototyping lowers development costs and time-to-market. Explainable AI is essential for resolving issues with accountability and transparency by guaranteeing that AI models utilized in research and development are comprehensible and interpretable. By serving as a link between the actual and virtual worlds, digital twins make it possible to monitor and optimize intricate systems and procedures in real time.

Automated Manufacturing Systems, Collaborative Robots in Manufacturing, and Data Analytics for Manufacturing and Logistics Systems are some of the terms that define the Manufacturing and Production sector. These innovations highlight how AI is revolutionizing factory efficiency and integrating collaborative robots. AI-driven automation in automated manufacturing systems reduces human intervention and boosts efficiency by streamlining production processes. Collaborative Robots in Manufacturing demonstrate how human employees and AI-powered robots may work together to improve productivity and safety in the workplace. Data Analytics for Manufacturing and Logistics Systems illustrates how artificial intelligence (AI) can be applied to operations analysis and optimization, enhancing resource management and decision-making.

The top keywords in the human resources context were business process management, social robots, and human performance augmentation. These phrases highlight AI's contribution to improving worker performance and streamlining HR operations. The use of AI to support or improve employee capabilities—possibly through training or real-time feedback—is known as human performance augmentation. The use of AI-driven robots in HR positions requiring human interaction, such onboarding or training, is known as social robots. AI is used by business process management to optimize and enhance HR procedures, improving decision-making and operational effectiveness.

The most common keywords for distribution and logistics were business process management, data analytics for manufacturing and logistics systems, and automated supply chain systems. These innovations show how supply chain processes can be optimized through the use of AI. From inventory control to transportation scheduling, automated supply chain systems use artificial intelligence (AI) to manage and automate logistics processes, increasing accuracy and lowering operating costs. Analyzing big information to find trends and improve logistics requires data analytics for manufacturing and logistics systems. The goal of business process management in this field is to improve supply chain efficiency by streamlining logistical workflows with AI.

Lastly, Cyber threat intelligence, System recovery, and Surveillance Robotic Systems are the top terms in Cyber-Security. The use of AI in protecting digital infrastructure and handling security events is reflected in these words. AI is used in cyber threat intelligence to identify and predict possible security risks, giving businesses useful information. AI-powered system recovery reduces downtime and data loss by improving the efficiency and speed of responses to cyber disasters. An additional degree of protection is provided by the use of AI-driven robots for physical space monitoring and security, which is known as surveillance robotic systems.

The examination of these keywords offers a thorough grasp of AI's functional integration within organizational contexts and insights into how it is used across different business units. In the upcoming survey round, these keywords will be cross-tabulated with Technical AI categories to evaluate their impact and alignment across various business areas. Appendix S has the full list of keywords for your reference.These lists, provide a thorough understanding of how AI is affecting both technical and business fields. The cross-tabulation analysis in the next survey round, where these keywords will be assessed according to their alignment with different business divisions and technical algorithms, will be guided by the results of this round. With the use of both general and specialized applications, this method seeks to provide nuanced insights about AI's function in organizational settings.

8.2.2 Appendix B: Survey Round 1 Qualitative Responses

Question 3:

1. Please indicate the areas in which you use techniques or systems that relate to Artificial Intelligence

Business Department	Not used	Slightly Used	Heavily used
Marketing/Sales			
Research & Development (R&D)			
Manufacturing and Production			
Human Resources			
Distribution and Logistics			
Cyber-Security			

Table B.1. Survey Question AI Usage in Various Business Departments

Respondent	Marketing/Sales	R&D	Manufacturing and Production	Human Resources	Distribution and Logistics	Cyber-Security
1	1 (Not used)	3 (Heavily used)	1 (Not used)	1 (Not used)	1 (Not used)	1 (Not used)
2	2 (Slightly used)	3 (Heavily used)	3 (Heavily used)	2 (Slightly used)	3 (Heavily used)	1 (Not used)
3	1 (Not used)	3 (Heavily used)	1 (Not used)	1 (Not used)	1 (Not used)	1 (Not used)
4	1 (Not used)	3 (Heavily used)	1 (Not used)	1 (Not used)	1 (Not used)	1 (Not used)
5	2 (Slightly used)	3 (Heavily used)	2 (Slightly used)	1 (Not used)	2 (Slightly used)	3 (Heavily used)
6	1 (Not used)	1 (Not used)	1 (Not used)	1 (Not used)	1 (Not used)	2 (Slightly used)
7	1 (Not used)	3 (Heavily used)	2 (Slightly used)	1 (Not used)	1 (Not used)	2 (Slightly used)
8	1 (Not used)	3 (Heavily used)	1 (Not used)	2 (Slightly used)	1 (Not used)	1 (Not used)
9	1 (Not used)	3 (Heavily used)	1 (Not used)	2 (Slightly used)	1 (Not used)	3 (Heavily used)
10	3 (Heavily used)	3 (Heavily used)	3 (Heavily used)	3 (Heavily used)	3 (Heavily used)	3 (Heavily used)
11	1 (Not used)	3 (Heavily used)	1 (Not used)	1 (Not used)	1 (Not used)	3 (Heavily used)
12	1 (Not used)	3 (Heavily used)	1 (Not used)	1 (Not used)	1 (Not used)	1 (Not used)
13	1 (Not used)	1 (Not used)	3 (Heavily used)	1 (Not used)	1 (Not used)	1 (Not used)
14	2 (Slightly used)	3 (Heavily used)	1 (Not used)	1 (Not used)	1 (Not used)	1 (Not used)
Average	**1.36**	**2.71**	**1.57**	**1.36**	**1.36**	**1.71**

Table B.2. Survey Responses AI Usage in Various Business Departments

Statistic	Marketing/Sales	R&D	Manufacturing and Production	Human Resources	Distribution and Logistics	Cyber-Security
Average	1.36	2.71	1.57	1.36	1.36	1.71
Median	1	3	1	1	1	1.5
Mode	1	3	1	1	1	1

Table B.3. Statistics AI Usage in Various Business Departments

2. What specific techniques or systems do you use that incorporate or relate to Artificial Intelligence? Please describe the AI methods, tools, or systems you apply in your work.

Respondent	Techniques/Systems	Description
1	Automatic Speech Recognition, Prompt-based AI	Uses automatic speech recognition frequently, with occasional use of tools like Copilot for research and writing assistance.
2	Convolutional Neural Networks (CNNs), Machine Learning	Applies CNNs and general machine learning methods.
3	CNNs, Recurrent Neural Networks (RNNs), Deep Neural Networks, Explainability Methods (SHAP)	Employs CNNs, RNNs, deep neural networks, and tools for explainable AI, such as SHAP.
4	Physical Unclonable Function (PUF)	Focuses on attacking physical unclonable functions for security purposes.
5	Spatial Statistics	Utilizes spatial statistical methods in AI-related work.
6	Phishing Detection, Malicious Data Detection	Works on identifying phishing attacks and detecting malicious data.
7	Transformers, Neural Networks, Anomaly Detection, Natural Language Processing (NLP)	Implements transformers, various neural networks, anomaly detection, and NLP techniques.

Table B.4. AI Techniques and Systems Reported by Respondents

As shown in Table B.4 of Appendix B, the respondents reported a wide variety of AI systems and approaches, demonstrating the breadth of AI applications within their professional activities. From fundamental approaches like neural networks and machine learning to specialized applications like phishing detection and attacking Physical Unclonable Functions (PUFs), which are suited to particular jobs or industries, this range of techniques covers it all.

Several responders brought up neural networks, such as CNNs, RNNs, and DNNs, emphasizing how commonplace they are for tasks like pattern recognition, image processing, and predictive modeling. This suggests that neural networks are a key component of many documented AI applications. The application of SHAP for explainability demonstrates a recognition of the importance of interpretability in AI models. This is consistent with the increasing focus on explainable AI in fields where knowledge of AI judgments and transparency are essential.

Methods like PUF assaults, malicious data detection, and phishing detection demonstrate an emphasis on data integrity and security. These answers highlight the value of artificial intelligence (AI) in detecting and reducing hazards in digital settings, which is becoming more and more important in cybersecurity-related fields.

All things considered, the range of answers highlights how versatile AI is for a wide range of jobs and sectors. This variety shows how adaptable AI applications are in advancing corporate goals and implies that AI technologies are being

customized to meet particular professional needs. The information gathered here shows the value of personalization in AI use and provides insights into how various AI approaches are applied by AI experts.

8.2.3 Appendix C: Survey Round 2 Cross-Tabulation

For the Technical AI Keyword List (Specific vs. Broad):

1. Rate each of the top 3 Technical AI keywords under each Technical Method according to how well it aligns with each Business Department on a scale from 0 to 2, with an additional option for "Not Sure."

    Scale: 0 (No Fit), 1 (Moderate Fit), 2 (Strong Fit)

2. Cross-tab these Technical AI keywords with one of the following Business Departments:
    Marketing/Sales
    Research & Development (R&D)
    Manufacturing and Production
    Human Resources
    Distribution and Logistics
    Cyber-Security

Technical AI Category	Technical AI Keywords	Marketing/Sales	R&D	Manufacturing and Production	Human Resources	Distribution and Logistics	Cyber-Security
Speech Recognition	Phonetics						
	Speech synthesis						
	Deep Learning Algorithms						
Image Recognition	Image motion analysis						
	Facial recognition						
	Scene understanding						
Machine Learning	Support vector machines						
	Reinforcement learning						
	Gradient tree boosting						
Knowledge-Based Systems	Rule-based systems						
	Expert system						
	Commonsense reasoning						

Table C.1. Survey Question Top 3 Technical AI Keywords of Each Technical Method vs. Business Departments

For the Business and Application-Oriented AI Keyword List (Specific vs. Broad):

1. Rate each of the top 3 Business and Application-Oriented AI keywords under each Business Department according to how well it aligns with each Technical Method on the same scale from 0 to 2, with an additional option for "Not Sure."

Scale: 0 (No Fit), 1 (Moderate Fit), 2 (Strong Fit) 2.

Cross-tab these Business and Application-Oriented AI keywords with one of the following Technical Methods:

Understanding of Speech
Image Recognition
Machine Learning
Knowledge-Based Systems

Business Department	Business AI Keywords	Speech Recognition	Image Recognition	Machine Learning	Knowledge-Based Systems
Marketing/Sales	Recommender Systems				
	Customer relationship management				
	Chatbots				
Research & Development (R&D)	Virtual prototyping				
	Explainable AI				
	Digital twins				
Manufacturing and Production	Automated Manufacturing Systems				
	Collaborative Robots in Manufacturing				
	Data Analytics for Manufacturing and Logistics Systems				
Human Resources	Human Performance Augmentation				
	Social robots				
	Business process management				
Distribution and Logistics	Automated Supply Chain Systems				
	Data Analytics for Manufacturing and Logistics Systems				
	Business process management				
Cyber-Security	Cyber threat intelligence				

	System recovery				
	Surveillance Robotic Systems				

Table C.2. Survey Question Top 3 Business and Application-Oriented AI Keywords vs. Technical AI Methods

Technical AI Category	Business and Application-Oriented AI Keywords	Respective average unique numbers ranked from highest to lowest
Speech Recognition	1. Chatbots	2.00115
	2. Social robots	1.50155
	3. Collaborative Robots in Manufacturing	1.5014
	4. Customer relationship management	1.2511
	5. System recovery	1.00185
	6. Cyber threat intelligence	1.0018
	7. Human Performance Augmentation	1.0015
Image Recognition	1. Social robots	1.75156
	2. Surveillance Robotic Systems	1.50191
	3. Collaborative Robots in Manufacturing	1.50141
	4. Automated Manufacturing Systems	1.25136
	5. Automated Supply Chain Systems	1.00166
	6. Data Analytics for Manufacturing and Logistics Systems	1.00146
	7. Explainable AI	1.00126
Machine Learning	1. Cyber threat intelligence	2.00182
	2. Recommender Systems	2.00107
	3. Chatbots	1.75117
	4. Data Analytics for Manufacturing and Logistics Systems	1.50172
	5. Automated Manufacturing Systems	1.50137
	6. Explainable AI	1.50127
	7. Surveillance Robotic Systems	1.25192
	8. System recovery	1.25187
Knowledge-Based Systems	1. Cyber threat intelligence	1.75183
	2. Business process management	1.50178
	3. Data Analytics for Manufacturing and Logistics Systems	1.50148
	4. System recovery	1.25188
	5. Human Performance Augmentation	1.25163
	6. Collaborative Robots in Manufacturing	1.25153
	7. Explainable AI	1.25143
	8. Recommender Systems	1.25128

Table C.3. Top Business and Application-Oriented AI Keywords vs. Technical AI Methods with Respective Average Unique Numbers

Important insights into how AI tools are strategically applied across various technical domains to address particular business needs can be gained from the analysis of the Top Business and Application-Oriented AI keywords associated with each technical method, see
Table C.3. ‘’Top Business and Application-Oriented AI Keywords vs. Technical AI Methods with Respective Average Unique Numbers’’ in Appendix C. Several important themes that highlight the ways AI helps different organizational activities through customized applications are shown by this investigation.

The Speech Recognition category emphasizes how important this technology is for automation, human support, and customer service. Important keywords like chatbot, social robot, and collaborative robots in manufacturing highlight the ways in which speech-based applications enhance automation, human interactions, and operational efficiency. While social robots, which use natural language processing, enable human-robot interactions in client-facing environments like retail and healthcare, chatbots play a crucial role in automating responses and improving the customer experience. Collaborative Robots in Manufacturing demonstrate how voice recognition helps with hands-free control of real-time operational activities, reducing manual interventions and promoting human-robot collaboration.

Terms like Social Robots, Surveillance Robotic Systems, and Collaborative Robots in Manufacturing highlight the significance of visual data processing in image recognition, particularly in automation and monitoring. With their ability to recognize images, social robots improve interaction by reacting to visual cues. This makes them ideal for environments that necessitate social interactions, like customer service. While collaborative robots in manufacturing use image recognition for quality control, further streamlining manufacturing processes, surveillance robotic systems highlight the significance of image recognition in security by spotting irregularities and improving safety in high-risk areas. Automated Manufacturing Systems and Automated Supply Chain Systems are two examples of terms that support the idea that image recognition is essential for streamlining industrial processes and reducing operational mistakes, especially in manufacturing and logistics.

The versatility and adaptability of machine learning applications in a range of corporate operations are highlighted by machine learning terms like chatbots, recommender systems, and cyber threat intelligence. By offering customized information, recommender systems are a prime example of how machine learning improves personalization, especially in industries like entertainment and e-commerce that gain from higher user engagement. Cyber Threat Intelligence illustrates how machine learning may be used to detect and resolve security issues, which is an essential task in industries where sensitive data is handled. Chatbots powered by machine learning are another example of how natural language processing and predictive analytics may improve consumer engagement while cutting expenses and raising satisfaction. Through applications like Automated Manufacturing Systems and Data Analytics for Manufacturing and Logistics Systems, which improve operational efficiency and predictive maintenance, machine learning also optimizes production and logistics decision-making.

Particularly in complex or high-stakes situations, knowledge-based systems play a unique role in structured knowledge application and decision support. The influence of Knowledge-Based Systems on workflow optimization, risk assessment, and production process improvement is reflected in key words like Cyber Threat Intelligence, Business Process Management, and Data Analytics for Manufacturing and Logistics Systems. While Business Process Management highlights the application of structured AI in simplifying operations and decreasing inefficiencies, Cyber Threat Intelligence in this area emphasizes the use of huge datasets to understand and mitigate security risks. Furthermore, the widespread use of phrases like System Recovery and Human Performance Augmentation highlights the ways in which Knowledge-Based Systems improve operational resilience and human-robot interaction, especially in manufacturing and logistics.

This comprehensive research yields three main themes that provide a strategic framework for departmental adoption of AI. First, the versatility of AI applications across technical techniques is evident, since technologies like cyber threat intelligence and data analytics are valuable in a variety of fields. This versatility highlights AI's potential for corporate applications in logistics, security, and customer service, promoting operational efficacy and efficiency across a range of functional domains.

Second, the frequent use of Explainable AI and Cyber Threat Intelligence in Machine Learning and Knowledge-Based Systems highlights security and transparency. Organizational priorities for fostering confidence and safeguarding vital resources are in line with this shared emphasis on protecting AI applications and maintaining openness. Companies are looking more and more for AI solutions that improve security while also offering decision-making procedures that are traceable and intelligible.

Last but not least, the importance of collaborative robots, automated systems, and manufacturing analytics in image and speech recognition demonstrates an emphasis on automation in production. This pattern demonstrates how the industrial sector is investing in AI-driven automation to boost competitiveness, lower costs, and increase productivity. AI helps manufacturing processes be more accurate and efficient through tasks like quality control, predictive maintenance, and workflow optimization.

In summary, this analysis highlights the significance of matching technical approaches with organizational requirements while offering a thorough perspective on AI's strategic application across business functions. The results offer a framework for companies to take use of AI's potential, facilitating departmental operational optimization, security improvement, and consumer engagement. For businesses looking to implement AI in a way that optimizes productivity and promotes a comprehensive strategy for departmental improvement, the cross-tabulation study provides a route

Technical AI Category	Business AI Keywords	Technical AI Keywords
Speech Recognition	Chatbots	Phonetics
	Social robots	Speech synthesis
	Collaborative Robots in Manufacturing	Deep Learning Algorithms
Image Recognition	Social robots	Image motion analysis
	Surveillance Robotic Systems	Facial recognition
	Collaborative Robots in Manufacturing	Scene understanding
Machine Learning	Cyber threat intelligence	Support vector machines
	Recommender Systems	Reinforcement learning
	Chatbots	Gradient tree boosting
Knowledge-Based Systems	Cyber threat intelligence	Rule-based systems
	Business process management	Expert system
	Data Analytics for Manufacturing and Logistics Systems	Commonsense reasoning

Table C.4. Top 3 Business AI & Technical AI Keywords for each respective Technical Method

Business Department	Technical AI Keywords	Respective average unique numbers ranked from highest to lowest
Marketing/Sales	1. Support vector machines	1.50062
	2. Scene understanding	1.50055
	3. Image motion analysis	1.50041
	4. Expert system	1.2509
	5. Gradient tree boosting	1.25076
Research & Development (R&D)	1. Reinforcement learning	2.0007
	2. Deep Learning Algorithms	2.00035
	3. Expert system	1.50091
	4. Gradient tree boosting	1.50077

	5. Support vector machines	1.50063
Manufacturing and Production	1. Expert system	2.00092
	2. Rule-based systems	1.50085
	3. Scene understanding	1.50057
	4. Commonsense reasoning	1.25099
	5. Gradient tree boosting	1.25078
Human Resources	1. Image motion analysis	1.50044
	2. Deep Learning Algorithms	1.50037
	3. Speech synthesis	1.5003
	4. Commonsense reasoning	1.251
	5. Expert system	1.25093
Distribution and Logistics	1. Expert system	2.00094
	2. Rule-based systems	1.50087
	3. Reinforcement learning	1.50073
	4. Commonsense reasoning	1.25101
	5. Support vector machines	1.25066
Cyber-Security	1. Gradient tree boosting	1.75081
	2. Deep Learning Algorithms	1.75039
	3. Expert system	1.50095
	4. Reinforcement learning	1.50074
	5. Commonsense reasoning	1.00102

Table C.5. Top 5 Technical AI Keywords of Each Technical Method vs. Business Departments with Respective Average Unique Numbers

A thorough understanding of how AI techniques are customized to match particular departmental needs and goals is provided by the combined analysis of the top five technical AI keywords across business departments. This analysis also identifies trends in the use of AI to improve decision-making, efficiency, and innovation across functions. Table C.5: Top 5 Technical AI Keywords of Each Technical Method vs. Business Departments (Appendix C) highlights the flexibility and adaptability of AI in assisting a range of corporate objectives by offering vital insights into the interaction between AI techniques and organizational activities.

In Marketing and Sales, AI's dependence on predictive analytics and visual data processing becomes apparent through keywords such as Support Vector Machines, Scene Understanding, and Image Motion Analysis. Support Vector Machines allow organizations to maximize sales tactics and personalize marketing strategies by facilitating consumer segmentation and behavior prediction. AI's importance in digital advertising is further shown by the existence of Scene Understanding and Image Motion Analysis, which improve consumer experience by facilitating targeted visual marketing and increasing interaction with visual elements. The department's emphasis on using visual AI and data categorization to enhance consumer engagement and strategic decision-making is demonstrated by these keywords.

Research and Development (R&D) departments point out sophisticated machine learning methods to foster innovation and challenging problem-solving. R&D's predilection for methods that facilitate data analysis, model creation, and high-accuracy predictive modeling—all essential for investigating new goods and carrying out scientific research—is highlighted by keywords like Deep Learning Algorithms, Reinforcement Learning, and Gradient Tree Boosting. The department's reliance on AI for data processing and testing is demonstrated by the existence of Expert Systems and Support Vector Machines, which facilitate the creation of AI-driven solutions. R&D departments may efficiently handle big datasets by incorporating scalable machine learning techniques, which promotes both innovation and exploratory research.

Manufacturing and Production departments value automation and decision-making through Expert Systems, Rule-Based Systems, and Scene Understanding. These terms highlight how AI can improve quality control, streamline troubleshooting procedures, and optimize manufacturing workflows. Contextual analysis is supported by Commonsense Reasoning, which makes error identification and predictive maintenance possible. Gradient Tree Boosting highlights the necessity of machine learning techniques that effectively handle large amounts of data in order to facilitate forecasting, resource optimization, and real-time production line modifications. In manufacturing environments, this use of AI increases accuracy, flexibility, and operational efficiency.

Human Resources (HR) divisions utilize AI for processing visually and cognitive data, improving functions such as hiring, educating employees, and performance assessment. Whereas speech synthesis facilitates employee and applicant engagement through automated communication tools, keywords like image motion analysis and deep learning algorithms point to AI's significance in talent management and applicant screening. HR's commitment to AI-driven insights for organized decision-making is demonstrated by the inclusion of Commonsense Reasoning and Expert Systems, which support assessment of performance and talent management. HR can maximize staff capabilities, encourage involvement, and boost productivity with an AI-driven strategy.

In distribution and logistics, AI facilitates dynamic decision-making and supply chain optimization. AI's importance in logistics is demonstrated by keywords like Expert Systems, Rule-Based Systems, and Reinforcement Learning, which allow for real-time decision-making, forecasting of demand, and route optimization. Context information derived from Commonsense Reasoning enables flexible reactions in dynamic situations, which is essential for effective inventory control and supply chain management. These solutions highlight the department's emphasis on AI-driven efficiency by facilitating real-time modifications and streamlining logistics procedures.

In Cybersecurity, AI supports in recognizing threats and forward-thinking risk control. The department's dependence on strong machine learning for evaluating big datasets to identify irregularities and forecast security concerns is demonstrated by the frequent appearance of Deep Learning Algorithms, Gradient Tree Boosting, and Expert Systems. While Commonsense Reasoning offers contextual knowledge necessary for traversing complicated security settings, Reinforcement Learning facilitates dynamic response capabilities, allowing real-time danger identification. By protecting vital infrastructure and facilitating automatic, intelligent responses, these products improve cybersecurity.

Three key conclusions may be drawn from this comprehensive examination. First, Expert Systems cross-functional relevance highlights how flexible they are in supporting a wide range of corporate tasks, from customer service to cybersecurity, and how they can be used to automate decision-making in a variety of scenarios. Second, the emphasis on data classification and predictive analytics—which is demonstrated by the widespread use of Support Vector Machines and Gradient Tree Boosting—highlights the need of deriving actionable insights from data so that AI can assist with activities like threat detection and consumer segmentation. Lastly, particular AI applications in domains like cybersecurity and human resources, such speech synthesis for engagement and reinforcement learning for security, show how AI technologies may be customized to meet particular departmental needs.

All things considered, these results shows that different departments implement AI differently based on different operational objectives, with common techniques like Expert Systems and Gradient Tree Boosting being extensively employed to improve organizational effectiveness and decision-making. Organizations can use AI's capabilities for a wide range of goals by strategically integrating it throughout business activities, which fosters resilience, adaptability, and competitive advantage.

Business Department	Technical Methods	Average numbers	Business Departments - Technical Keywords
1. Marketing/Sales	1. Machine Learning	1.2521	Support vector machines
	2. Speech Recognition	1.25196	Scene understanding
	3. Knowledge-Based Systems	1.00217	Image motion analysis
	4. Image Recognition	1.00203	Expert system
2. Research & Development (R&D)	1. Knowledge-Based Systems	1.50218	Reinforcement learning
	2. Machine Learning	1.50211	Deep Learning Algorithms
	3. Speech Recognition	1.50197	Expert system
	4. Image Recognition	1.25204	Gradient tree boosting
3. Manufacturing and Production	1. Machine Learning	1.75212	Expert system
	2. Image Recognition	1.75205	Rule-based systems
	3. Knowledge-Based Systems	1.25219	Scene understanding
	4. Speech Recognition	0.75198	Commonsense reasoning
4. Human Resources	1. Knowledge-Based Systems	1.5022	Image motion analysis
	2. Machine Learning	1.50213	Deep Learning Algorithms

	3. Image Recognition	1.25206	Speech synthesis
	4. Speech Recognition	1.25199	Commonsense reasoning
5. Distribution and Logistics	1. Machine Learning	1.75214	Expert system
	2. Knowledge-Based Systems	1.25221	Rule-based systems
	3. Image Recognition	1.25207	Reinforcement learning
	4. Speech Recognition	0.752	Commonsense reasoning
6. Cyber-Security	1. Machine Learning	1.75215	Gradient tree boosting
	2. Knowledge-Based Systems	1.25222	Deep Learning Algorithms
	3. Image Recognition	0.75208	Expert system
	4. Speech Recognition	0.75201	Reinforcement learning

Table C.6. Top 4 Technical Methods vs Business Departments

Table C.6. shows the cross-tabulation of Business Departments and Technical AI Methods. Appendix C, which compares the Top 4 Technical Methods to Business Departments, provides a number of insights into the many ways AI technologies are used in various organizational tasks. We can identify patterns and trends in the ways AI supports certain demands within these tasks by looking at how each business department uses AI techniques.

The analysis's main finding is that some AI methods are widely applicable. For example, machine learning is highly fitting in all six business departments, demonstrating its adaptability. Machine learning is frequently used for activities ranging from improving cybersecurity procedures to optimizing marketing strategies. Machine learning models are useful for identifying irregularities and anticipating possible threats. They are well-known for its predictive analytics skills and support for process automation.

Speech recognition is particularly useful in internal operations like human resources and in customer-facing divisions like marketing and sales. Its inclusion in these domains emphasizes how crucial speech-driven AI is for enhancing corporate communications, promoting security measures, and facilitating customer engagement. For example, HR departments may utilize speech recognition technology in training, onboarding, or recruitment scenarios to improve employee experiences and streamline interactions, while marketing/sales departments use it to automate customer support through chatbots.

Image recognition has its highest rankings in the department of Cyber-Security, and Manufacturing and Production in particular. While image recognition can help with surveillance footage monitoring and security procedure reinforcement, On the other hand, image recognition is used in applications where visual data processing and object detection are essential, such as quality control of production lines in manufacturing and production, and cyber-security surveillance.

Knowledge-Based Systems are widely used in divisions including Cyber-Security, Distribution and Logistics, and Human Resources. This pattern illustrates how important knowledge management is in various fields. By offering thorough access to organized knowledge, these systems probably improve decision-making procedures, streamline logistics operations, and support talent management. The incorporation of knowledge-based systems into cybersecurity implies that knowledge management powered by AI plays a crucial role in identifying and reducing possible risks. Distribution and Logistics, on the other hand, place the highest priority on knowledge-based systems, which reflects an emphasis on supply chain management decision-making that is optimized.

According to the results of this cross-tabulation, companies would profit from matching their AI strategy to the particular requirements of every division. Shared AI platforms may help departments that use cross-functional technologies like image recognition and machine learning by facilitating resource pooling and cost reduction. On the other hand, specialty divisions like Cyber-Security can need specially designed AI solutions to handle their particular problems.

Overall, the analysis shows that some AI techniques are suited to specific tasks, while others have universal applications. Organizations can optimize their AI investments by coordinating AI deployment with departmental needs. This will lead to targeted enhancements and a unified AI strategy throughout the company. By creating an integrated AI environment, this customized strategy not only guarantees that every department has access to the resources required for their operations but also raises the competitiveness of the entire organization.

Business Department	Technical AI Keywords	Business AI Keywords
Marketing/Sales	Support vector machines	Recommender Systems
	Scene understanding	Customer relationship management

	Image motion analysis	Chatbots
Research & Development (R&D)	Reinforcement learning	Virtual prototyping
	Deep Learning Algorithms	Explainable AI
	Expert system	Digital twins
Manufacturing and Production	Expert system	Automated Manufacturing Systems
	Rule-based systems	Collaborative Robots in Manufacturing
	Scene understanding	Data Analytics for Manufacturing and Logistics Systems
Human Resources	Image motion analysis	Human Performance Augmentation
	Deep Learning Algorithms	Social robots
	Speech synthesis	Business process management
Distribution and Logistics	Expert system	Automated Supply Chain Systems
	Rule-based systems	Data Analytics for Manufacturing and Logistics Systems
	Reinforcement learning	Business process management
Cyber-Security	Gradient tree boosting	Cyber threat intelligence
	Deep Learning Algorithms	System recovery
	Expert system	Surveillance Robotic Systems

Table C.7. Top 3 Technical AI & Business AI Keywords for each respective Business Department

The analysis of AI applications across different business departments, as summarized in Table C.7 below reveals how specific AI tools align with departmental objectives to enhance efficiency, decision-making, and innovation. Each department benefits from a unique combination of technical and business AI tools, tailored to meet its distinct operational needs. This alignment provides organizations with targeted strategies to leverage AI for optimal performance.

In the Marketing and Sales department, Support Vector Machines, Scene Understanding, and Image Motion Analysis are advocated as significant technical AI tools that facilitate customer evaluation and improve graphic engagement. Support vector machines create a database for tailored marketing tactics by enabling accurate client segmentation and behavior prediction. Targeted visual content in digital advertising is made possible by scene understanding and image motion analysis, which further improves consumer experiences. When combined with business AI tools like chatbots, CRM, and recommender systems, these technologies enable marketing teams to communicate with customers more efficiently and successfully, which leads to higher conversion. Marketing and sales can increase customer pleasure, loyalty, and engagement by combining data-driven and customer-facing AI technologies.

For Research and Development (R&D), sophisticated machine learning methods like Reinforcement Learning, Deep Learning Algorithms, and Expert Systems drive complex research and innovation. While Deep Learning Algorithms make data analysis and pattern detection easier, Reinforcement Learning makes adaptable experimenting possible, which is essential for exploratory studies. Expert systems facilitate testing hypotheses and model creation, which expedites the R&D process. These technical tools are enhanced by business AI tools like digital twins, explainable AI, and virtual prototyping, which provide openness and shorten the development process. Digital twins connect virtual and real-world applications, explainable AI fosters trust by making decision-making clear, and virtual prototyping enables simulation before physical production. When combined, these resources produce a productive and creative R&D environment that promotes cutting-edge testing and product creation.

In Manufacturing and Production, Expert Systems, Rule-Based Systems, and Scene Understanding enhance automation and control over quality. On production lines, expert systems and rule-based systems improve troubleshooting and process optimization by offering systematic guidance on decisions. Real-time monitoring is made possible by scene understanding, which is crucial for upholding quality standards in automated systems. Operations are further streamlined by complementary business AI solutions including Data Analytics for Manufacturing and Logistics, Collaborative Robots, and Automated

Manufacturing Systems. By lowering the need for human actions, increasing productivity, and offering predictive insights, these tools contribute to the development of an extremely effective manufacturing environment that prioritizes accuracy, robustness, and productivity.

Human Resources draws on AI to enhance employment, instruction, and retention of staff, employing technical instruments like Image Motion Analysis, Deep Learning Algorithms, and Speech Synthesis. Speech synthesis improves collaboration during onboarding and training, while image motion analysis and deep learning help with talent evaluation and customized growth plans. Human resources processes are further enhanced by business solutions including business process management, social robots, and human performance augmentation. These solutions assist HR teams in developing a data-driven, encouraging environment that maximizes staff efficiency and satisfaction by automating tedious operations, enabling structured insights, and improving worker interaction.

In Distribution and Logistics, Expert Systems, Rule-Based Systems, and Reinforcement Learning manage the department's desires for efficiency and mobility. Logistics management, including inventory control and route optimization, is structuredly supported by expert systems and rule-based systems, while dynamic, real-time decision-making is supported by reinforcement learning. By making inventory and transportation management easier, business AI tools like Automated Supply Chain Systems, Data Analytics for Manufacturing and Logistics, and Business Process Management improve operation performance. By using these tools, logistics can adjust to the intricate demands of the supply chain and provide prompt, affordable solutions.

Cybersecurity branches utilize methods based on machine learning such as Gradient Tree Boosting, Deep Learning Algorithms, and Expert Systems to detect and respond to threats. Expert systems offer organized structures for security decision-making, while gradient tree boosting and deep learning algorithms enable proactive threat identification through sophisticated identification of patterns. By providing constant monitoring, fast response times, and physical security measures, complementary business AI products like Cyber Threat Intelligence, System Recovery, and Surveillance Robotic Systems improve cybersecurity operations. By strengthening cybersecurity protections, this all-encompassing combination protects both digital and physical infrastructure.

Table C.6 provides a coherent framework for organizational growth by showing how each department might strategically use particular AI technologies to achieve its own goals. Organizations can improve decision-making, resilience, and departmental efficiency by integrating technical AI technologies with business-oriented applications. A comprehensive strategy for AI-driven organizational performance is supported by the patterns that have been found, which highlight the importance of customized AI applications across domains, from cybersecurity to customer interaction.

Business Department	Technical Methods	Business Departments - Technical Keywords	Business Departments - Business Keywords
1. Marketing/Sales	1. Machine Learning	Support vector machines	Recommender Systems
	2. Speech Recognition	Scene understanding	Customer relationship management
	3. Knowledge-Based Systems	Image motion analysis	Chatbots
	4. Image Recognition	Expert system	Social robots
2. Research & Development (R&D)	1. Knowledge-Based Systems	Reinforcement learning	Virtual prototyping
	2. Machine Learning	Deep Learning Algorithms	Explainable AI
	3. Speech Recognition	Expert system	Digital twins
	4. Image Recognition	Gradient tree boosting	Image tagging
3. Manufacturing and Production	1. Machine Learning	Expert system	Automated Manufacturing Systems
	2. Image Recognition	Rule-based systems	Collaborative Robots in Manufacturing
	3. Knowledge-Based Systems	Scene understanding	Data Analytics for Manufacturing and Logistics Systems

	4. Speech Recognition	Commonsense reasoning	Failure Detection and Recovery
4. Human Resources	1. Knowledge-Based Systems	Image motion analysis	Human Performance Augmentation
	2. Machine Learning	Deep Learning Algorithms	Social robots
	3. Image Recognition	Speech synthesis	Business process management
	4. Speech Recognition	Commonsense reasoning	Chatbots
5. Distribution and Logistics	1. Machine Learning	Expert system	Automated Supply Chain Systems
	2. Knowledge-Based Systems	Rule-based systems	Data Analytics for Manufacturing and Logistics Systems
	3. Image Recognition	Reinforcement learning	Business process management
	4. Speech Recognition	Commonsense reasoning	Manufacturing, Maintenance and Supply Chains
6. Cyber-Security	1. Machine Learning	Gradient tree boosting	Cyber threat intelligence
	2. Knowledge-Based Systems	Deep Learning Algorithms	System recovery
	3. Image Recognition	Expert system	Surveillance Robotic Systems
	4. Speech Recognition	Reinforcement learning	Control Systems

C.8. Top 4 Technical Methods & Technical AI & Business AI Keywords for each respective Business Department

The cross-tab analysis of Technical Methods, Technical AI algorithms, and Business AI applications across various business departments, as summarized in Table C.8 ‘’Top 4 Technical Methods & Technical AI & Business AI Keywords for each respective Business Department’’, reveals distinct patterns and strategic alignments, highlighting how different AI tools enhance departmental goals by addressing unique operational needs. Rather than focusing on isolated findings, this section suggests broader organizational trends that reflect a common approach to leveraging AI for optimal performance. With certain technologies showing broad applicability and others showing more specific use, the findings provide insightful information about the various roles that AI methods play within enterprises. The analysis reveals four main themes, each of which emphasizes the distinct contributions that particular AI technologies provide to improving organizational adaptability, decision-making, and efficiency in departments.

The adaptability of machine learning, which covers a range of applications from threat identification, segmentation of customers, and managerial decision-making to predictive analytics, is a noteworthy trend throughout every division. Because of its versatility, machine learning is at the core of AI initiatives for businesses looking for scalable, data-driven insights. Support vector machines and other machine learning approaches, for example, offer a strong basis for consumer segmentation and behavior prediction in the marketing and sales division, making it easier to develop customized marketing plans. These machine learning capabilities, when combined with commercial AI applications like recommender systems, allow for more individualized client engagement, which boosts the efficiency of marketing and sales initiatives. The versatility of machine learning is further demonstrated in cybersecurity, where proactive threat identification and quick reaction are supported by Gradient Tree Boosting in combination with Cyber Threat Intelligence systems. This wide range of applications highlights machine learning's status as a flexible, cross-functional technology that is crucial for improving operational effectiveness and decision-making in a variety of corporate scenarios.

Additionally, the data shows that manufacturing and production, as well as distribution and logistics, place a high priority on automation and quality control. Both departments use technical AI technologies, such as Rule-Based Systems and Expert Systems, to optimize processes and automate decision-making, which lessens the need for human interaction. Expert systems and rule-based systems optimize production lines in manufacturing and production, guaranteeing effective decision support and troubleshooting. Business AI solutions like Automated Manufacturing Systems and Data Analytics for Manufacturing and Logistics Systems, which reduce human intervention and enable predictive maintenance, complement these technological algorithms and increase efficiency. Expert systems and rule-based systems optimize logistics management,

including inventory control and route optimization, demonstrating a comparable alignment between distribution and logistics. A thorough approach to automation in these divisions is reinforced by the implementation of Automated Supply Chain Systems and Data Analytics for Manufacturing and Logistics, which show how AI-driven procedures improve operational durability and cost-effectiveness by guaranteeing preciseness and effectiveness across the supply chain.

Departments that interact with customers, such as marketing, sales, and human resources, show a clear emphasis on improving communication and engagement. In these areas, artificial intelligence (AI) solutions like speech recognition and image recognition are essential because they enhance interactions between customers and employees. Speech recognition technologies like Scene Understanding and Image Motion Analysis are used in marketing and sales to improve the consumer experience by enabling more specialized visual material for digital advertising. Business AI technologies like chatbots and CRM systems, which facilitate real-time engagement and expedite customer communication, are combined with these technical AI applications. Similar AI capabilities in HR facilitate training and employee engagement. While Social Robots and Human Performance Augmentation offer an interactive, data-driven HR environment, Image Motion Analysis and Speech Synthesis support talent evaluation and customized development programs. These results show AI's role in improving user happiness and operational efficiency in service-oriented domains by demonstrating how AI technologies that improve engagement and expedite communication are strategically employed in customer and employee-focused roles.

Last but not least, the cybersecurity trend highlights how AI, through sophisticated machine learning and decision-support systems, contributes to resilience and security. To facilitate threat detection, response, and system recovery, cybersecurity departments rely on technological techniques such as machine learning and knowledge-based systems. Protecting organizational assets requires proactive pattern and danger identification, which is made possible by gradient tree boosting and deep learning algorithms. These techniques are used in conjunction with corporate AI solutions that provide thorough monitoring and quick response times, such Cyber Threat Intelligence and Surveillance Robotic Systems. Expert systems in cybersecurity also facilitate organized decision-making, especially in intricate security situations when prompt, well-informed action is crucial. The focus on expert-driven support systems and machine learning in cybersecurity highlights the value of AI in protecting physical and digital infrastructure and making sure that businesses are resilient to changing threats. Knowledge-based system technologies, like Human Performance Augmentation and Commonsense reasoning for HR, and systems like Business Process Management and Expert systems for R&D, have become essential in these departments due to their capacity to support strategic decision-making and effective operations.

In conclusion, Table C.8 demonstrates how AI can be strategically aligned with departmental objectives, providing a coherent framework for AI deployment across functions. Each department benefits from a combination of technical AI methods and business applications tailored to its specific operational needs. This alignment not only supports productivity and decision-making within departments but also allows organizations to maximize the impact of their AI investments by creating a cohesive, resilient infrastructure. While AI technologies like machine learning are useful across departments, additional specialized methods like speech recognition or image recognition are essential for accomplishing departmental objectives, according to the patterns seen across the many business activities. Organizations may create a responsive, effective, and flexible corporate structure that improves performance in all domains by matching AI strategies with operational demands.

Business Department	Technical Methods - Business Department	Business Departments - Technical Keywords	Business Departments - Business Keywords	Technical Methods	Technical Methods - Technical Keywords	Technical Methods - Business Keywords
1. Marketing/ Sales	1. Machine Learning	Support vector machines	Recommender Systems	**1. Speech Recognition**	Phonetics	Chatbots
	2. Speech Recognition	Scene understanding	Customer relationship management		Speech synthesis	Social robots
	3. Knowledge-Based Systems	Image motion analysis	Chatbots		Deep Learning Algorithms	Collaborative Robots in Manufacturing
	4. Image Recognition	Expert system	Social robots		Natural Language Processing	Customer relationship management
2. Research &	1. Knowledge-	Reinforcement learning	Virtual prototyping		Named entity recognition	System recovery

Development (R&D)	Based Systems					
	2. Machine Learning	Deep Learning Algorithms	Explainable AI		Semi supervised learning	Cyber threat intelligence
	3. Speech Recognition	Expert system	Digital twins	**2. Image Recognition**	Image motion analysis	Social robots
	4. Image Recognition	Gradient tree boosting	Image tagging		Facial recognition	Surveillance Robotic Systems
3. Manufacturing and Production	1. Machine Learning	Expert system	Automated Manufacturing Systems		Scene understanding	Collaborative Robots in Manufacturing
	2. Image Recognition	Rule-based systems	Collaborative Robots in Manufacturing		Convolutional neural networks	Automated Manufacturing Systems
	3. Knowledge-Based Systems	Scene understanding	Data Analytics for Manufacturing and Logistics Systems		Scene anomaly detection	Automated Supply Chain Systems
	4. Speech Recognition	Commonsense reasoning	Failure Detection and Recovery		Deep learning algorithms	Data Analytics for Manufacturing and Logistics Systems
4. Human Resources	1. Knowledge-Based Systems	Image motion analysis	Human Performance Augmentation	**3. Machine Learning**	Support vector machines	Cyber threat intelligence
	2. Machine Learning	Deep Learning Algorithms	Social robots		Reinforcement learning	Recommender Systems
	3. Image Recognition	Speech synthesis	Business process management		Gradient tree boosting	Chatbots
	4. Speech Recognition	Commonsense reasoning	Chatbots		Deep Learning Algorithms	Data Analytics for Manufacturing and Logistics Systems
5. Distribution and Logistics	1. Machine Learning	Expert system	Automated Supply Chain Systems		Semi supervised learning	Automated Manufacturing Systems
	2. Knowledge-Based Systems	Rule-based systems	Data Analytics for Manufacturing and Logistics Systems		Feedforward neural networks	Explainable AI
	3. Image Recognition	Reinforcement learning	Business process management	**4. Knowledge-Based Systems**	Rule-based systems	Cyber threat intelligence
	4. Speech Recognition	Commonsense reasoning	Manufacturing, Maintenance and Supply Chains		Expert system	Business process management
6. Cyber-Security	1. Machine Learning	Gradient tree boosting	Cyber threat intelligence		Commonsense reasoning	Data Analytics for Manufacturing and Logistics Systems
	2. Knowledge-Based Systems	Deep Learning Algorithms	System recovery		Inductive Logic Programming	System recovery
	3. Image Recognition	Expert system	Surveillance Robotic Systems		Control systems	Human Performance Augmentation
	4. Speech Recognition	Reinforcement learning	Control Systems		Bayesian network	Collaborative Robots in Manufacturing

C.9. All cross-tabulations conducted in the survey round 1 and 2 (containing Top 4 Technical Methods & Technical AI- and Business AI Keywords for each respective Business Department + Top 6 Technical AI- and Business AI Keywords for each respective Technical Method)

8.3 Appendix D. Raw Data or Code

8.3.1 Raw Data Description Excel Formulas

In order to analyze the survey data effectively and calculate the average scores for each keyword in the cross-tabulation of Technical AI Keywords vs. Business Methods, the following Excel formulas were applied. These formulas allow for a systematic evaluation and ranking of keywords based on their relevance as indicated by the respondents.

1. Calculating the Average of All Respondents for Each Keyword

For each keyword in the cross-tabulation, the following formula was used to calculate the average score for all respondents. The formula searches for the relevant keyword category within the dataset and assigns the appropriate value from the survey responses:

```excel
=IF(OR(ISNUMBER(SEARCH("1. Speech Recognition", S4)),
ISNUMBER(SEARCH("2. Image Recognition", S4)),
ISNUMBER(SEARCH("3. Machine Learning", S4)),
ISNUMBER(SEARCH("4. Knowledge-Based Systems", S4)),
ISNUMBER(SEARCH("1. Marketing/Sales", S4)),
ISNUMBER(SEARCH("2. R&D", S4)),
ISNUMBER(SEARCH("3. Manufacturing and Production", S4)),
ISNUMBER(SEARCH("4. Human Resources", S4)),
ISNUMBER(SEARCH("5. Distribution and Logistics", S4)),
ISNUMBER(SEARCH("6. Cyber-Security", S4))),
```

S23, "")

```

This formula ensures that the survey responses for each keyword under a specific business or technical category are accurately captured and averaged.

2. Creating a Unique Identifier for Each Keyword

To ensure that each keyword is uniquely identified for further analysis, the following formula was applied to generate an average unique number:

```excel
=IF(OR(ISNUMBER(SEARCH("1. Speech Recognition", T3)),
    ISNUMBER(SEARCH("2. Image Recognition", T3)),
    ISNUMBER(SEARCH("3. Machine Learning", T3)),
    ISNUMBER(SEARCH("4. Knowledge-Based Systems", T3)),
    ISNUMBER(SEARCH("1. Marketing/Sales", T3)),
    ISNUMBER(SEARCH("2. R&D", T3)),
    ISNUMBER(SEARCH("3. Manufacturing and Production", T3)),
    ISNUMBER(SEARCH("4. Human Resources", T3)),
    ISNUMBER(SEARCH("5. Distribution and Logistics", T3)),
    ISNUMBER(SEARCH("6. Cyber-Security", T3)),
    ISNUMBER(SEARCH("Not Sure", T3))),
```
```

```
  IF(T4<>"", T4 + COLUMN(T4)/100000, ""),

  "")
```

This formula allowed for the creation of a unique numerical identifier for each keyword, making it possible to distinguish and rank the keywords based on their average score.

3. Ranking Keywords by Their Average Unique Number

To rank the keywords within a specific category, such as "1. Marketing/Sales," the following formula was used to order the unique average numbers from highest to lowest:

```excel
=LARGE($T$33:$CX$33, COLUMN(A1))
```

This formula returns the largest values from the unique average numbers in descending order, effectively creating a ranking of keywords.

4. Matching the Top-Ranked Keywords to Their Names

Once the keywords were ranked by their average score, the following formula was employed to match the highest scores to the corresponding keyword names:

```excel

=INDEX($T$3:$CX$3, MATCH(T34,$T$33:$CX$33, 0))

```

This formula retrieves the keyword names based on their ranking, ensuring that the final list displays the top keywords in each category.

5. Final Results for 1. Marketing/Sales

Using the aforementioned formulas, the top keywords for the "1. Marketing/Sales" category were identified as follows:

- Support vector machines
- Scene understanding
- Image motion analysis
- Expert system
- Gradient tree boosting
- Commonsense reasoning
- Rule-based systems
- Reinforcement learning
- Facial recognition
- Deep Learning Algorithms
- Speech synthesis

- Phonetics

These formulas, combined with the systematic approach to keyword ranking, provided a clear overview of which AI technologies are most relevant to each business function, based on the data collected from the respondents.

8.3.2 Raw Data Tables second survey

Statistic values	Phonetics - 1. Marketing/Sales	Phonetics - 2. R&D	Phonetics - 3. Manufacturing and Production	Phonetics - 4. Human Resources	Phonetics - 5. Distribution and Logistics	Phonetics - 6. Cyber-Security
	0	2	0	2	0	2
	0	1	1	0	0	0
	2	1	0	1	0	0
	0	2	1	2	0	2
	1	1	0	2	0	0
	0	2	0	1	0	1
Average	0.5	1.5	0.3	1.3	0.0	0.8
Average Unique number	0.5	1.5	0.3	1.3	0.0	0.8
Ranking Average Unique number	1.5	1.3	0.8	0.5	0.3	0.2
Index keyword names	Phonetics - 2. R&D	Phonetics - 4. Human Resources	Phonetics - 6. Cyber-Security	Phonetics - 1. Marketing/Sales	Phonetics - 3. Manufacturing and Production	Phonetics - Not Sure

Table D.1. The index list of the keyword Phonetics