Research on AI's Impact on Asset Management – Potential Use for GPIF's Overall Operations

Final Report

2018/3/31

accenturestrategy

Agenda

I. Objectives of This Research

II. Opportunities to Use AI for Pension Management
  1. Approach for Using AI
  2. Opportunities to Use AI
    (1) Application for Operational Efficiency Improvement
    (2) Potential for Enhancing Asset Management
  3. Recommended Initiatives for GPIF

III. Medium- to Long-Term Development of AI

IV. Approach of GPIF

Objectives of This Research

Identify the opportunities and the benefits of AI in long-term investment, and determine an effective use of AI in outsourcing asset management operations staffed with a small number of people.

Objectives of This Research

(From the RFP)

Background of GPIF

- GPIF can influence the domestic investment environment and the flow of risk money in the medium- to long-term due to its size and investment stance.
- GPIF, as a “universal owner,” contributes to secure common interests in the medium- to long-term throughout the investment chain.
  - Promotion of ESG investment
  - Promotion of the exercise of voting rights
  - Dialogue through various forums
- The potential of the use of AI in asset management has been recognized, and there are growing expectations to utilize it for medium- to long-term use.

Objectives of This Assignment

- The use of AI for long-term asset management to contribute to the common interests of pension recipients, asset management firms, and GPIF.
- GPIF is expected to proactively use AI in long-term asset management, an area where there are few precedents.
- For this reason, we will identify the potential impact of AI with respect to the three areas to help consider acquiring common interests.

(1) Potential use in long-term management of pension assets.

The scope of this research

(2) Potential use in GPIF’s overall operations.

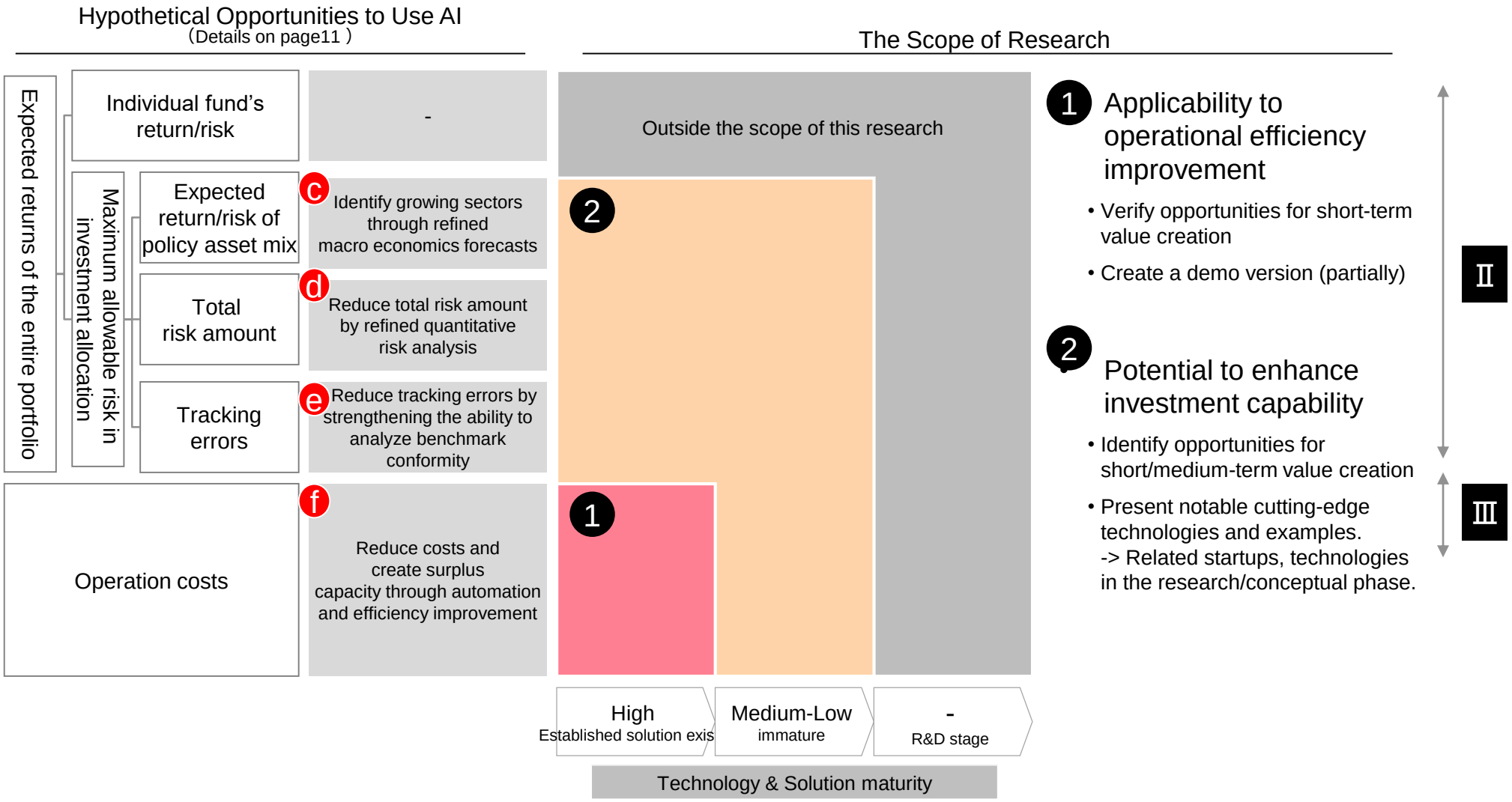
(3) Impact on the business model of asset management firms.

Issues to be Considered in Depth

1. How much productivity improvement can be expected when using AI for investment operations of pension reserve fund?
2. How can AI add value to GPIF as it engages in its unique task of working with asset management firms?
3. Which area has the highest potential to sophisticate asset management?

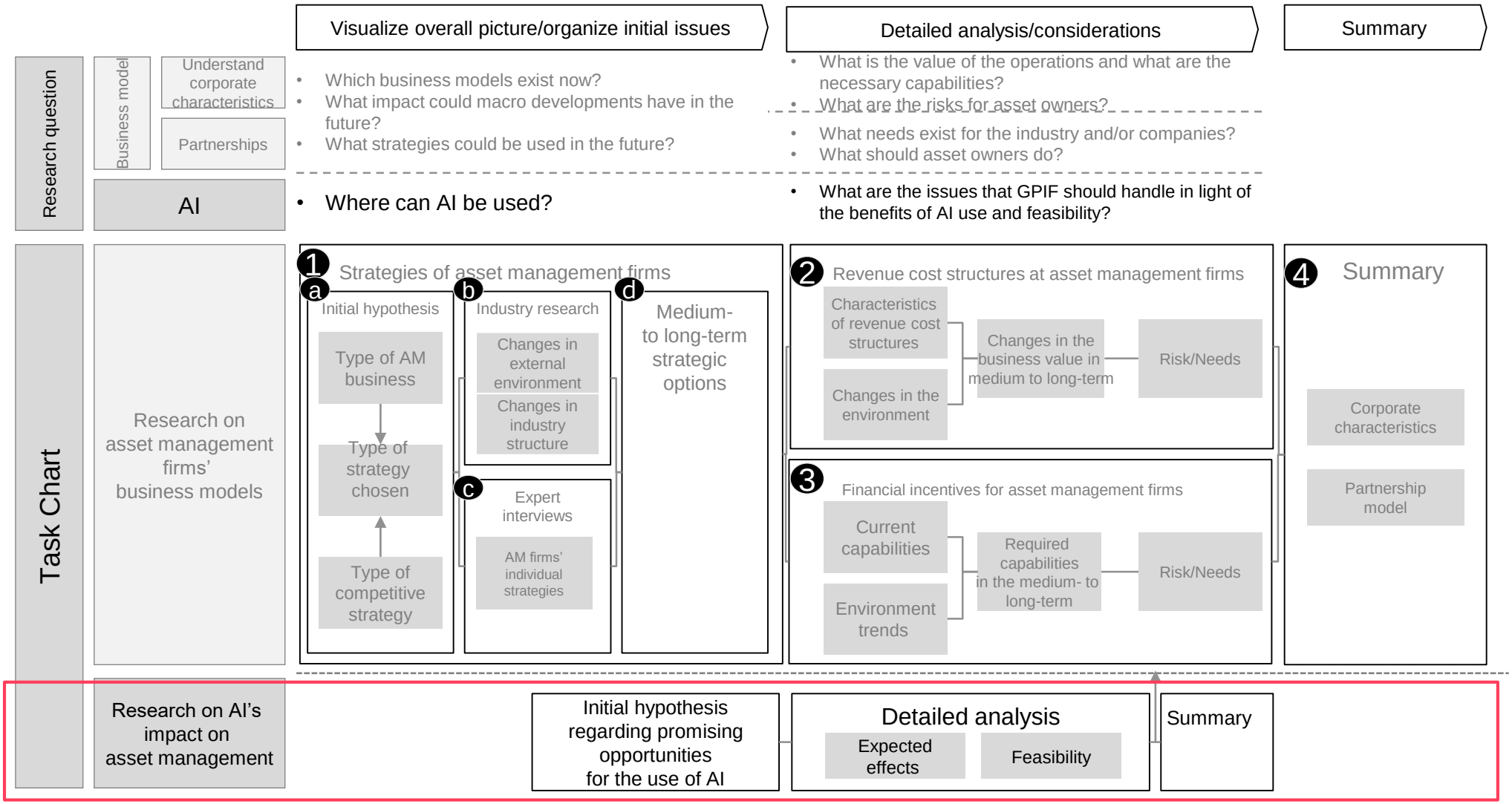
Research Approach: Concept

This research will examine the scope of AI applications used to improve operational efficiency at GPIF, and the possibility to use AI to sophisticate asset management for the medium- to long-term.



Research Approach: How to Proceed

Provide an overview of the potential uses of AI based on recent technology trends to identify promising opportunities in line with the operations of GPIF.



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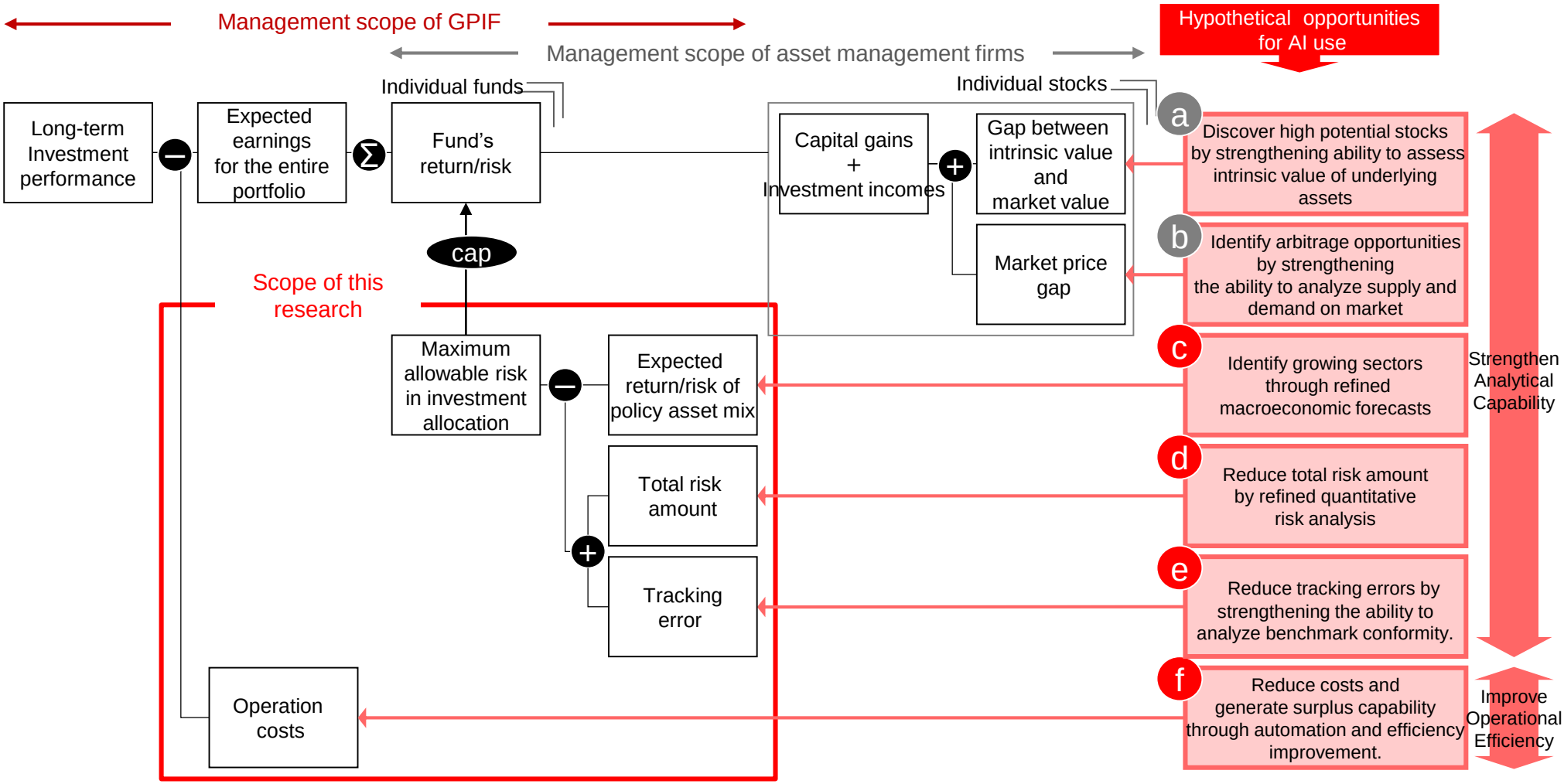
Opportunities to Use AI in Long-Term Investment of Pension Reserve Fund

There are six major opportunities to use AI to improve long-term investment performance.

Performance creation model for long-term investment of pension reserve fund



c Refinement of macro forecasts
d Refinement of quantitative risk analysis
e Refinement of benchmark conformity
f Automation & Efficiency Improvement

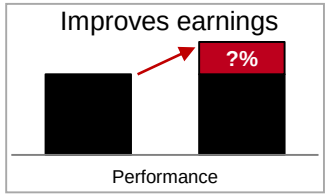
AI's Contribution to GPIF Operations (Summary)

The evaluation and analysis capabilities of AI makes it possible to improve the quantity and quality of the information used to formulate policy asset mix and fund selection.

Expected benefits

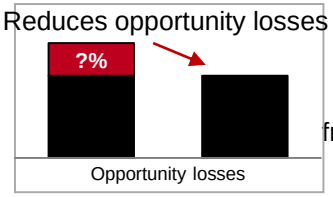
Improve Investment Performance (expected returns)

× **Optimize portfolio**



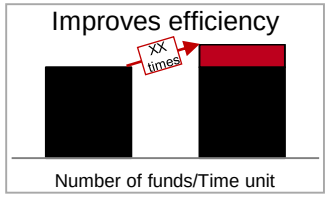
→ Refine Investment Target

× **Optimize fund selection**

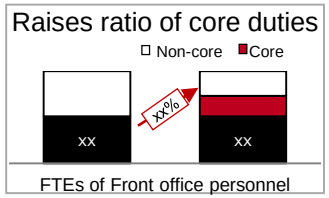


→ Identify high-quality funds, Improves frequency, accuracy of fund evaluation

× **Improve fund management**

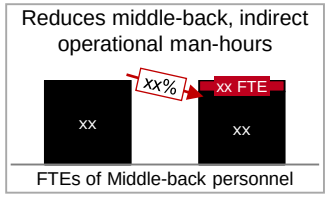


→ Improves quantity and quality of information analysis (xx times)



→ Raises the ratio of core operations (xx times)

− **Reduce operational man-hours**



→ Reduces supplementary/ indirect work (xx%)

What AI can accomplish (example)

Improve investment return through refined allocation (c)

- Improve investment strategies through a better grasp of macroeconomic trends.
- Refine macro-risk evaluation at sector-specific levels, refines long-term risk evaluation.

Minimize opportunity losses through selection of high-quality funds (d e)

- Assist with decision-making in minimizing the return/risk target gap through a better understanding of actually owned assets.
- Visualize tracking errors by analyzing factors that diverge from the portfolio.
- Assist to find high-quality funds by strengthening the abilities to evaluate the performance of individual funds.

Improve productivity of front office to enhance fund mgmt. capacity (f)

- Automate collection of externally unstructured information/Recommend important and related information.
- Assist with analyzing information provided by asset managers.
- Automate collection of structured data for routine analysis.

Improve operational efficiency of non-core business at front office (f)

- Improve effectiveness of data access.
- Automate routine research.
- Automate routine documentation.

Improve efficiency of non-core operation (f)

- Automate expense reimbursement, etc.

Improves efficiency at middle and back sections (f)

- Automate cash management operation.
- Automate bylaws inquiry.
- Automate management fee calculation.

Improve efficiency of non-core operation (f)

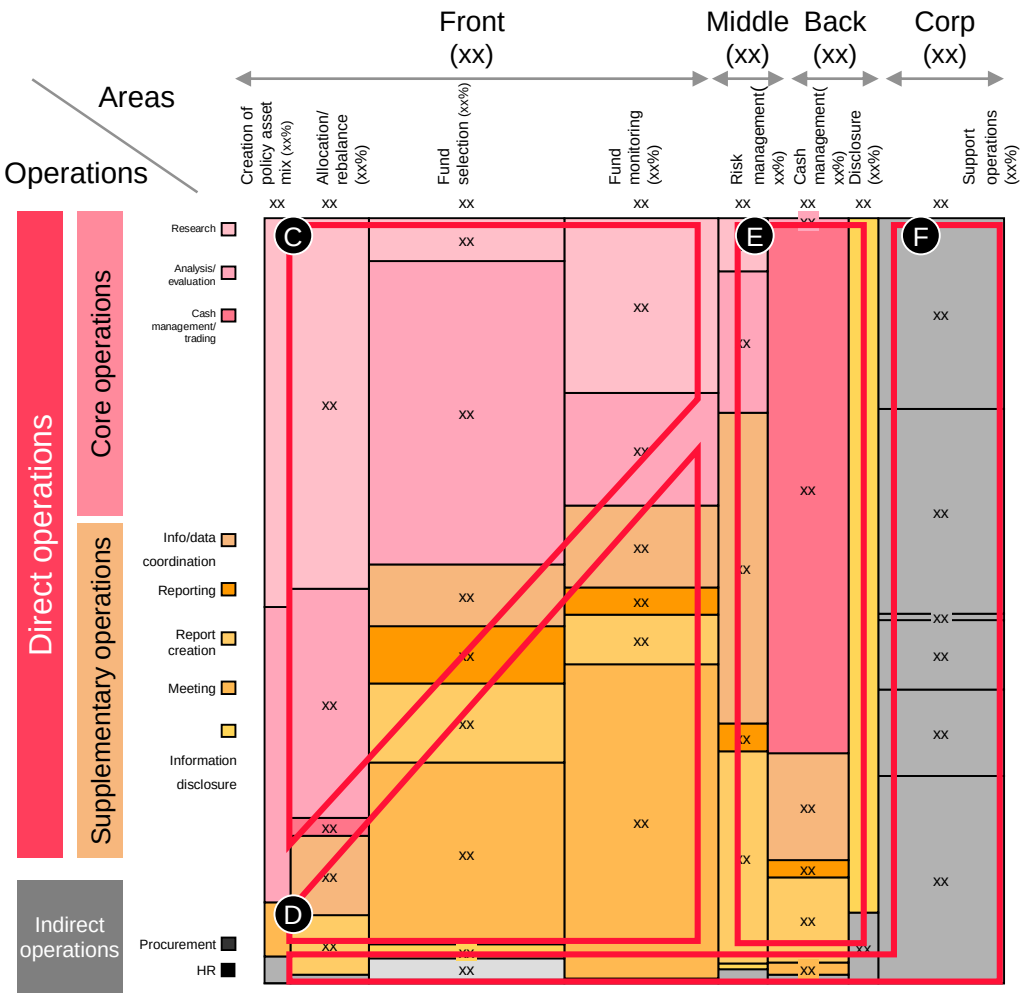
- Automate compliance check.
- Automate security checks.

2. Opportunities to Use AI: (1) Operational Efficiency Improvement

Hypothesis of Applications to ① Operational Efficiency Improvement

From the standpoint of improving work efficiency, priority should be given to areas where the significant improvement is expected core operations in front office where the quality enhancement is expected in addition to efficiency improvement.

Application areas in GPIF operations Unit: FTE



*Compiled based on GPIF work flow and interviews with each department; only operations in which the number of man-hours has been identified are included

Hypothetical reform opportunities to improve efficiency

C Improve productivity of front office to enhance fund mgmt. capacity

Expected benefits

- C-1. Automate collection of externally unstructured information/Recommend important and related information.
- C-2 Assist with analyzing information provided by asset managers.
- C-3 Automate collection of structured data for routine analysis.

xx~xx / xxFTE

D Improve operational efficiency of non-core businss at front office

- D-1. Automated transcription of meetings.
- D-2. Automated routine documentation.
- D-3. Improve data usability through common data platform.
- D-4. Improve information searches related to data disclosures at parliamentary sessions and other occasions.
- D-5. Automate collection of external unstructured information, improves search capabilities.

xx~xx / xxFTE

E Improves efficiency at middle and back offices

- E-1. Automate cash management entries.
- E-2. Automate bylaws inquiry improves search capabilities.
- E-3. Calculate asset management fees.

xx~xx / xxFTE

F Improve efficiency of non-core operation

- F-1. Automate expense reimbursement operation.
- F-2. Automate application, approval procedures of IT asset administration.
- F-3. Automate compliance checks.
- F-4. Automate security checks.

xx~xx / xxFTE

2. Opportunities to Use AI: (1) Operational Efficiency Improvement

Use Cases for Operational Efficiency Improvement (1/7)

By improving the efficiency of front office core operations, GPIF can enhance the depth and breadth of information from outside and make better use of it.

C Improve productivity of core operations in front office

Use Case	Changes		Expected benefits	
	Current	After AI introduction	Improvements	Application/Expanded use
C-1. Automated gathering of external information	[Research] ① Front office staffs use terminals and the internet to search the news (30 minutes to 1 hour). ② Skim top pages, scan the day's news using keyword searches, and examine articles of high interest. ③ Keep data by adding them to the browser's bookmark or storing them in individual folders.	① AI comprehensively searches preset data sources and collects information related to keywords. ② Learns users' individual preferences, identifies information that is of interest to particular users, and distributes it to each front office staffs. ③ Assigns relative importance to the info, attaches tags, and stores it with other related data.	• Improvements in search speed, accuracy. • Expanded scope of the information search. • Keeping the info with added data ensures the ease of search and analysis.	• Can be applied to more complex and specialized uses than news searches. - Automatically obtains information on director appointments and hiring at asset management firms, and obtains press releases. - Automatically obtains and compares performance data of overseas pension funds, data on outsourced asset management firms, and asset allocations, etc.
C-2. Automated analysis of information provided by asset-management firms	[Evaluation of contracted firms] ① An asset management firm provides performance reports, DDQ (PPT, PDF, etc.). ② A person in charge, using his/her own criteria, examines the document. • Existence/non-existence of inconsistencies, unclear statements. • Consistency of qualitative comments, numerical data. • Inconsistencies with previous reports, etc. ③ Records questions sent to the asset management firm and the response received. ④ Manually checks relevant information as necessary when creating reports or evaluating funds.	① AI conducts analysis based on preset criteria. • Extracts important indicators and comments. • Certain expressions that require particular attention. • Identification of items with a great divergence from previous reports. • Comparison with other funds, etc. ② Automatically screens and identifies items that must be closely examined. ③ Stores the analysis results to make annual comparisons possible.	• Removes individual subjectivity and improves quality. • Makes it easier to conduct an analysis that spans many years, evaluates the performance of asset management firms on a long-term basis.	• Analyzes how different funds react to the same macroeconomic event. • Evaluates information submitted by asset management firms over many years. • Obtains documents through a manager entry system. • Evaluates consistency in GPIF's own fund evaluations.

2. Opportunities to Use AI: (1) Operational Efficiency Improvement

Use Cases for Operational Efficiency Improvement (2/7)

(Continued from the previous page)

C Improve productivity of core operations in front office

Use Case	Changes		Expected benefits	
	Current	After AI introduction	Improvements	Application/Expanded use
C-3. Automated collection of information on manager entry system	[Fund selection] ① Transfers manager entry information emailed from asset management firms to a master file (Excel). ② Obtains evaluation info from outside organizations (such as Mercer GIMD) and adds it to the master file. ③ Sends emails to asset management firms that have failed to update information and urges them to take action.	① PRA automatically transfers information from asset management firms to the master file. ② RPA also automatically collects outside information, such as data from Mercer. ③ Automatically sends emails to asset management firms that have failed to provide information and urges them to take action.	• Reduced man-hours in standardized information management. • More refined information, surplus capacity for staff to allow for more extensive and in-depth evaluations.	• Automated filtering and simplified evaluations based on specific criteria. • Expansion of outside information regarding evaluation targets. • Collection of information on funds that are outside the manager entry application system.
C-4. Automated information collection, automated analysis in evaluating funds	[Fund evaluation] ① Collects information from asset management firms' performance reports and transfers it to a master file (Excel). ② Conducts standardized data compilation and analysis. ③ Carries out further analysis for areas that require more research.	① Uses PRA to automatically obtain outside data and records them in a certain format. ② Automatically conducts standardized analysis and records the results on a shared database. ③ Each staff member carries out additional analysis where in-depth research is needed.	• Reduced man-hours in obtaining input data for standardized analysis. • Reduced human errors. • Analysis of related sections and better access to original data.	• Expansion of the scope of information collection. • Comparisons among funds. • The use of the same angle to analyze funds that are not currently hired to discover high-quality funds.
C-5. Automated data gathering and routine analysis for risk reporting	[Fund evaluation] ① Collects information from information providers, inhouse systems, and performance reports. ② Conducts data compilation and analysis using the Excel VBA and functions. ③ Carries out further analysis for areas that require more research.	① Uses PRA to automatically obtain outside data and records it in a certain format. ② Automatically conducts standardized analysis and records the results on a shared database. ③ Each staff member carries out additional analysis where in-depth research is needed.	• Reduced man-hours in obtaining input data for standardized analysis. • Reduced human errors. • Analysis of related sections and better access to original data.	• Increase in the frequency of analysis. • Expansion in input information. • Comparison over the years using past data.

2. Opportunities to Use AI: (1) Operational Efficiency Improvement

Use Cases for Operational Efficiency Improvement (3/7)

By automating operations and making information access more efficient, GPIF can increase the productivity of supplementary operations of the front office to make room for core operations.

D Improve efficiency of supplementing operations in front office to make room for core operations

Use Case	Changes		Expected benefits	
	Current	After AI introduction	Improvements	Application/Expanded use
D-1. Automated transcription of meetings	[Meetings] ① Holds meetings to collect information from asset management firms and to evaluate funds. ② Creates minutes for the meeting for distribution to relevant staffs. ③ Must look into the file to seek information if certain confirmations are needed.	① AI converts voice data into text and records the content of the meeting. ② A staff member creates minutes based on the text. ③ Tags and keywords are attached to the file and the minutes.	• No need to attend the meeting as an audience. • Minutes can be created quickly. • Less communication with the person creating the minutes.	• The technology to automatically summarize texts may soon be put into practical use, making it possible to automatically create minutes.
D-2. Automated routine documentation	[Report creation] ① Staffs of each department obtain the necessary information by coordinating with other sections, examining past documents and searching outside sources. ② They enter information on a standard form and make revisions. ③ Confirmation and approval. ④ Each department retains the output.	① AI automatically collects info necessary for changes in the standard output. ② AI suggests entry candidates; a staff makes the selection or enters a different value. ③ Stores output data in an information platform for use as entry info when creating a standard document.	• Reduced man-hours in creating standard documents such as announcements, PR, procurement, annual reports and contracts.	• Questionnaire forms for interviews with funds. • Create questions used in document evaluations of the manager entry system. • Approval notifications regarding the manager entry system and distribution of email requesting updated data.
D-3. Improved search capabilities through an inhouse data sharing platform	[Cash management, data disclosure] ① Front, middle and back offices individually obtain necessary data. ② They enter data or process it for analysis. ③ Each department stores and manages data.	① Converts data to a digital format and stores it in a shared platform. ② Uses a natural-language recognition system to attach tags to the document, creates associations, and adds other information (such as document type). ③ Makes information access efficient through various keyword search functions and search functions for related documents.	• Reduced communication and administrative tasks related to data coordination. • Reduced time lag for data acquisition. • Improved capabilities to obtain unknown data and past data.	• Cash balance data. • Bylaws • Contracts. • Information provided by asset management firms. • Performance reports.

2. Opportunities to Use AI: (1) Operational Efficiency Improvement

Use Cases for Operational Efficiency Improvement (4/7)

(Continued from the previous page)

D Improve efficiency of supplementing operations in front office to make room for core operations

Use Case	Changes		Expected benefits	
	Current	After AI introduction	Improvements	Application/Expanded use
D-4. Related information search and consistency checks in disclosing information	[Information disclosure] ① To prepare for documents for parliamentary discussions and to respond to external inquiries, staffs obtain information from paper media, data held by departments, and documents available online. ② They read documents, create reports, and confirm consistency with related documents.	① Information disclosed in the past is stored in a shared platform, tagged, and associated. ② When new information is disclosed, the AI automatically searches related documents, identifies differences and confirms consistency.	• Improved quality of consistency checks. • Reduced man-hours to confirm similarities and consistency with past documents. • Reduced tasks related to coordination among departments.	n/a
D-5. Automated search and acquisition of structured external information	[Research] ① Staffs (in investment strategy, research and actuary, and risk management, etc.) access outside information providers. ② They obtain market information using Excel, web browsers and email. ③ They edit data in accordance with the analysis format.	① Specified market data is stored through an inhouse data platform with a specified format. ② Staffs access current and cumulative information for each data item.	• Improved efficiency in obtaining standard data related to the policy asset mix and risk management. • Improved efficiency in obtaining data for risk analysis.	• Movements of individual stocks, indexes and other market info. • Interest rates in various markets.
D-6. Automated document translation	[Research, asset management firm management, fund selection] ① Staffs read information disclosed by overseas asset management firms and related foreign-language documents. They translate such documents as necessary and share the content.	① AI handles translations between Japanese and foreign languages.	• Improves efficiency in document reading. • Improved efficiency in sharing externally-disclosed information. • Better access to foreign-language sources.	n/a

2. Opportunities to Use AI: (1) Operational Efficiency Improvement

Use Cases for Operational Efficiency Improvement (5/7)

In middle & back operations, promising areas include automation of routine entry work, creation of bylaws database, and using AI to improve search capabilities.

E Improve productivity in middle and back offices

Use Case	Changes		Expected benefits	
	Current	After AI introduction	Improvements	Application/Expanded use
E-1. Automated cash management entry	[Cash management] ① Staffs spend 1-2 hours each day obtaining data necessary for cash schedule management from Excel, email and other sources. ② They manually enter the data using standard forms.	① By RPA, data is automatically entered into a standard form. ② A staff confirms the accuracy of data entered.	• Reduced man-hours due to automated entry of standard cash schedule data. • Improved service quality with no human errors.	n/a
E-2. Automated response to inquiries and improved search capabilities of bylaws	[Rule changes] ① In response to internal inquiries about bylaws, an inquirer or staff in charge of regulatory affairs obtains the documents or reference data managed by each department. ② This person reads the bylaws in the order that they are obtained without knowing in advance whether they are relevant, then identifies the bylaws that seem applicable. ③ The person in charge will determine whether these bylaws are applicable.	① AI suggests the bylaws and related information relevant to the search from an inhouse data platform that contains all bylaws. ② The inquirer only reads relevant information and discusses the applicable bylaws with the person-in-charge.	• Reduced man-hours involving internal inquiries regarding bylaws and related documents • Reduced time lag in information coordination. • More efficient search for past documents when signing a contract or creating new bylaws in diversifying assets.	n/a
E-3. Automated calculation of asset management fees	[Fee calculation] ① A person at the investment administration department receives raw data for fee calculation from funds twice a year. ② This person spends 1-2 months calculating fees. ③ Another person confirms the figure.	① AI automates data reception from funds, enters the data into the calculation format and calculates. ② A staff confirms the appropriateness of the refenced data, calculation, etc.	• Reduced man-hours involving standardized entry and calculation. • Improved service quality owing to fewer human errors, reduced man-hours for checking work.	n/a

2. Opportunities to Use AI: (1) Operational Efficiency Improvement

Use Cases for Operational Efficiency Improvement (6/7)

As for indirect operations, GPIF can improve the efficiency significantly by automating expense reimbursement and applications for information security management.

F Improve efficiency of indirect operations

Use Case	Changes		Expected benefits	
	Current	After AI introduction	Improvements	Application/Expanded use
F-1. Automated expense reimbursement	[Cash management] ① Each department creates expense reimbursement request forms. ② Each department prepares certifying documents. ③ The documents are sent to the accounting department. ④ Approved. ⑤ The accounting department reimburse expenses. ⑥ Gives cash or arranges a bank transfer. ⑦ The money is deposited.	① AI reads the receipt and automatically enters the expense item, amount, date and time. ② AI confirms the generated expense request document and transfers data to the accounting department. ③ The accounting department confirms the certifying document and approves. ④ The reimbursement and payment amount is approved. ⑤ The money is deposited.	• Entry, calculation, and payment procedures for general and travel expenses become more efficient. • Eliminating human work reduces human errors.	• Procedures for changes in employee addresses, bank transfer accounts, etc.
F-2. Automated request and approval procedure for IT-asset administration	[Administration of IT assets] ① The information security department receives applications from each department. ② Determines the need for escalation based on the application and the required response level. ③ Subsequent implementation.	① AI automatically sorts the applications and the person in charge at the information security department only handles requests that require escalation. ② Subsequent implementation.	• Improved operational efficiency at the information security department for procedures related to various applications and escalations. • Reduced time lag until the response is made.	n/a

2. Opportunities to Use AI: (1) Operational Efficiency Improvement

Use Cases for Operational Efficiency Improvement (7/7)

(Continued from the previous page)

F Reduce indirect operation

Use Case	Changes		Expected benefits	
	Current	After AI introduction	Improvements	Application/Expanded use
F-3. Internal compliance monitoring	[Compliance Check] ① External email communications take place. ② The person in charge of compliance check reads emails and takes escalation measures for emails that could be in violation.	① AI gives alerts on external email communications with a strong possibility of compliance violations. The person in charge determines the need for escalation. ② AI learns the results of the escalation decisions.	• Monitoring of external email communications; more efficient compliance violation checks. • Improved identification of compliance violations owing to the elimination of subjectivity by humans.	n/a
F-4. Automated security check for firms under contract	[Compliance check] ① Sends security check sheets to outsourced asset management firms. ② These firms fill out the sheets and front office staffs collect them. ③ The front office staffs share the response with the information security officer. ④ The information security officer checks the security status. ⑤ If there is a flaw, the front office staffs will be asked to carry out additional communications with the asset management firms.	① The information security officer creates a security survey sheet. ② Sends the survey sheet to asset management firms through the security check system. ③ AI automatically processes the response, then sends automated alerts to firms that have failed to submit a response or have submitted a flawed report.	• More efficient communications between the front office staffs and asset management firms for information security survey. • More refined methods to confirm the security status of asset management firms. • Asset management firms' responses to changes in security requirements can be confirmed in a unified fashion.	• Survey sheets for asset management firms' compliance status. • Survey sheets regarding efforts to comply with initiatives promoted by GPIF, such as ESG.

2. Opportunities to Use AI: (1) Operational Efficiency Improvement

Brief Evaluation of Effectiveness (1/2)

[Legend]
× Unnecessary
✓ Necessary

Promising areas include automation of information gathering and the strengthening of data use through a data sharing platform.

	Use Case	Operational uniqueness		Expected benefits					Technical maturity			
				Efficiency effect		Reduced man hours		Information utilization sophistication		Major elemental technologies	Learning	Implementation
			Applicable operations		Target process	min	max					
C Improve productivity of core operations in front office	**C-1.** Automated gathering of external information	High	Creation of policy asset mix, rebalance	High	Research			High	Low	・Crawling ・Sentence analysis ・RPA	✓	✓
	C-2. Automated analysis of information provided by asset management firms	High	Fund selection, evaluation	Low	Analysis/ evaluation			High	Low	・AI OCR ・Text mining	✓	✓
	C-3. Automated collection of information on manager entry system	High	Fund evaluation, risk management	High	Report creation			High	High	・Crawling ・RPA	×	✓
	C-4. Automated information collection, automated analysis in evaluating funds	High	Fund evaluation, risk management	High	Report creation			High	High	・Crawling ・RPA	×	✓
	C-5. Automated data gathering and routine analysis for risk reporting	High	Fund evaluation, risk management	High	Report creation			High	High	・Crawling ・RPA	×	✓
D Improve efficiency of supplementary operations in front office to make room for core operations	**D-1.** Automated transcription of meetings	Low	Meetings with asset management firms, internal meetings	Low	Meetings			High	High	・Voice recognition ・Speaker recognition	×	✓
	D-2. Automated routine documentation	Low	Document publication, creation of internal meeting documents	High	Report creation			Low	High	・Text mining ・Automated document creation	×	✓
	D-3. Improved search capabilities through an inhouse data sharing platform	High	Risk analysis	High	Data coordination			High	High	・Text search engine ・Text mining	×	✓
	D-4. Related information search and consistency checks in disclosing information	Low	Confirmation of consistency with past documents, creation of FAQs	Low	Information disclosure			High	Low	・Text management tool ・Text search engine	✓	✓

2. Opportunities to Use AI: (1) Operational Efficiency Improvement

Brief Evaluation of Effectiveness (2/2)

[Legend]
× Unnecessary
✓ Necessary

D-5 and D-6 to benefit in both operational efficiency and information utilization advancement. There is also room for efficiency improvement in M/B operations and indirect operations and in accounting.

	Use Case	Operational uniqueness		Expected benefits					Technical maturity			
				Efficiency effect				Information utilization sophistication		Major elemental technologies	Learning	Implementation
			Applicable operations		Target process	Reduced man hours min	Reduced man hours max					
D	**D-5.** Automated search and acquisition of structured external information	Low	Standardized research, etc.	High	Research			High	High	・RPA ・Crawling	×	✓
D	**D-6.** Automated document translation	Low	Standardized research, etc.	High	Research			High	High	・Natural-language processing	×	✓
E	**E-1.** Automated cash management entry	Low	Schedule update, etc.	Low	Cash management			Low	High	・RPA	×	✓
E	**E-2.** Automated response to inquiries and improved search capabilities of bylaws	Low	Confirmation of bylaws in signing contract, etc.	Low	Data coordination			High	Low	・Natural-language processing	✓	✓
E	**E-3.** Automated calculation of asset management fees	Low	Fee payments to funds	Low	Cash management			Low	High	・RPA	×	✓
F	**F-1.** Automated expense reimbursement	Low	Expense reporting, Travel expense settlement, etc.	High	Cash management			Low	High	・AI OCR ・Expenses reimbursement tool	×	×
F	**F-2.** Automated request and approval procedure for IT-asset administration	Low	Use of IT assets	Low	Support for other operations			Low	High	・Escalation administration tool	×	✓
F	**F-3.** Automated Internal compliance monitoring	Low	Internal compliance check	Low	Support for other operations			Low	Low	・Text mining ・Sentiment analysis	✓	✓
F	**F-4.** Automated security check for firms under contract	High	Security check for asset management firms	Low	Support for other operations			High	High	・Database ・Survey tool	×	✓

D Improves productivity in mid & back offices

E Reduce indirect operations

2. Opportunities to Use AI: (2) Enhance Investment Capability

Use cases to Enhance Investment Capability (1/3)

AI allows for refined economic forecasts and risk evaluations by using leading indicators and the subdivision of analysis units.

A Improve investment return through refined allocation

	Use Case	Assumed effects
c Advanced investment strategy by refining the macroeconomic trends analysis and longer forecasts	**A-1.Refined management goal-setting based on leading indicators** Refinement of long-term economic assumptions using leading indicators, refinement of asset management goal-setting based on longer-term forecasts.	Increasing the accuracy of economic forecasts using a wide range of data and leading indicators (such as transport activities and recruitment info) will help refine asset management goal-setting.
	A-2. Optimized allocation through refinement of economic forecast calculations Optimization of allocation at the level of asset class, region and investment method.	Subdivides the units of economic growth forecasts at the sector and regional levels and helps optimize the asset allocation so that an appropriate risk-return distribution can be achieved at the levels of asset class, region and investment method, etc., rather than at the levels of Japanese/non-Japanese bonds/equities.
c Refining the evaluation of macroeconomic risks/ long-term risk evaluation	**A-3.Refined risk evaluation based on leading indicators** Refinement of market and liquidity risk analysis through the acquisition of a wider range of leading indicators.	Detects increases in volatility and a decreases in liquidity based on price movement data analysis. Evaluates market risks more accurately to help achieve refined asset allocations.
	A-4. Subdivision of risk evaluation Refinement of evaluations by creating a risk evaluation model that reflects the characteristics of assets, sectors and investment methods.	Identifies the risks that could not be visualized in the past (such as sector-specific risks) to provide necessary input for the creation of a more stable investment strategy. This achieves a more refined understanding of risks and strengthens the ability to take risks.

2. Opportunities to Use AI: (2) Enhance Investment Capability

Use cases to Enhance Investment Capability (2/3)

A “look-through” approach to analyze the assets invested by funds provides more accurate expected returns and allows for risk visualization when managing and evaluating portfolios.

B Minimize opportunity losses through selection of high-quality funds

	Use Case	Assumed effects
d Minimizing the gap between actual and target return on risk by analyzing assets under management	**B-1. Visualization of expected earnings for the entire portfolio through a “look-though” approach** Expand the unit of analysis from individual funds to the companies in which the funds invest. Understand the gap between the expected return on the overall portfolio and on individual funds.	Expands the analysis from each fund to the investees of each fund and understanding the expected returns more precisely. This will be helpful when reallocating funds.
	B-2.Visualization of the risks of assets that are actually owned In evaluating risks, evaluate the fund and the individual securities included in the fund. Evaluate the risks using a “look through” approach.	Based on the information held by each fund regarding the investees, conducts evaluations of market and the liquidity risks to obtain a more refined evaluation of the risks associated with the assets that are actually owned. This will lead to stronger risk-taking capabilities.
e Visualizing tracking errors by analyzing the factors that deviate from policy asset mix (PAM)	**B-3. Controlling tracking errors by visualizing the gap between PAM and actual portfolio** Keep track of the divergence between the investment position and the predetermined composition ratio of the policy asset mix, thereby detecting tracking errors before they occur and controlling them through rebalancing.	Based on the forecast prices of asset classes and individual securities, predicts composition changes and divergences, assisting with appropriate rebalancing decisions.

c Refinement of macro forecasts
d Refinement of quantitative risk analysis
e Refinement of benchmark conformity
f Automation & Efficiency Improvement

Use cases to Enhance Investment Capability (3/3)

Evaluating and comparing individual funds' investment performance over time to strengthen the ability to select high-quality funds.

B

Minimize opportunity losses through selection of high-quality funds

d e

Strengthening evaluation capabilities of individual funds' performance to identity high-quality funds

Use Case	Assumed effects
B-4. Assisting in analyzing investment performance based on funds' track records In supervising outsourced asset management firms or selecting candidates, automating the analysis of the target fund's track records will allow for more detailed analysis of a wider variety of funds, increasing the chances of finding high-quality funds.	Assists in evaluating funds' performance by comparing individual funds over time and comparing the track records of several funds within the same category.
B-5. Advancement in fund investment evaluation and analysis Monitoring investment activities of outsourced asset management firms to visualize the speed and consistency of their responses to price changes or other specific economic events.	Making it possible to evaluate investment activities over time, or to compare several funds in the same category to evaluate the funds' performance in a more timely and effective manner.
B-6.Refined abilities to grasp the risks effectively held by funds Obtaining funds' investment information more frequently, monitoring their risk management status to evaluate their risk management abilities, and making monitoring a real-time activity.	Instead of relying only on risk management reports submitted by funds, conducts market and liquidity risk analysis based on the position held by each fund, thereby closely evaluating the risks effectively held by the funds.

c Refinement of macro forecasts
d Refinement of quantitative risk analysis
e Refinement of benchmark conformity
f Automation & Efficiency Improvement

Brief Evaluation of Effectiveness

A-1,3, which uses leading indicators, and B4,5, which strengthens fund evaluation capabilities, are promising.

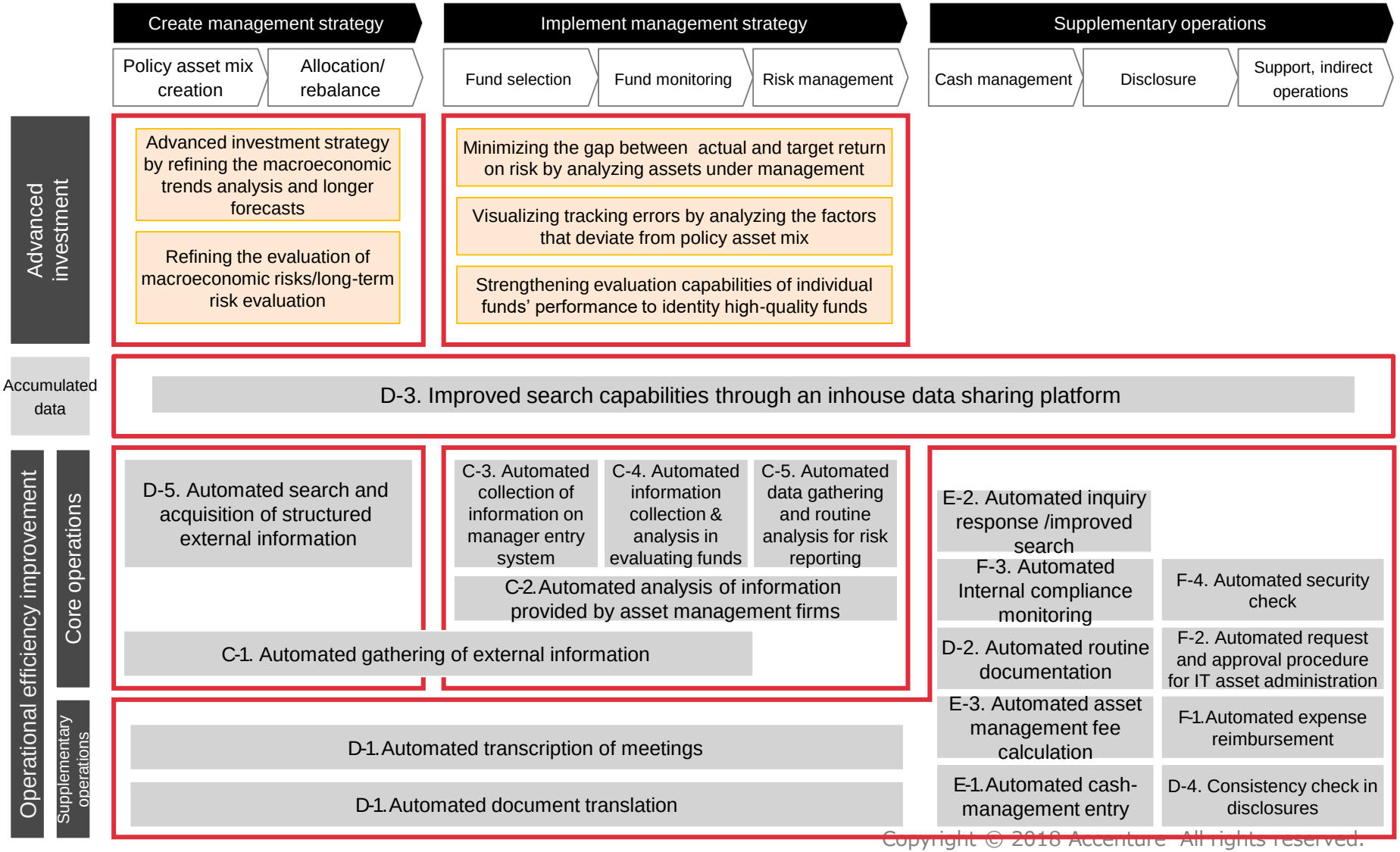
		Use Case	Operational uniqueness	Expected benefits	Technical maturity			
			Applicable operations	Information utilization sophistication		Feasibilities: Learning	Feasibilities: Implementation	Major elemental technologies
A Improve investment return through refined allocation	c Advanced investment strategy by refining the macroeconomic trends analysis and longer forecasts	**A-1.** Refined management goal-setting based on leading indicators	**High**	Investment goal-setting, risk factor analysis, etc.	**High**	Low	Necessary	Necessary	• Bayesian NW • Text analysis, etc.
		A-2. Optimized allocation through refinement of economic forecast calculations	Low	Creation of policy asset mix/revisions, etc.	**High**	Low	Necessary	Necessary	• Graph analysis • Cluster analysis, etc.
	c Refining the evaluation of macroeconomic risks/ Refined long-term risk evaluation	**A-3.** Refined risk evaluation based on leading indicators	**High**	Risk factor analysis, risk management, etc.	**High**	Low	Necessary	Necessary	• Cluster analysis • Pattern analysis • Text analysis, etc.
		A-4. Subdivision of risk evaluation	Low	Fund strategy evaluation, fund risk evaluation, etc.	**High**	Low	Necessary	Necessary	• Pattern analysis • Cluster analysis, etc.
B Minimize opportunity losses through selection of high-quality funds	d Minimizing the gap between actual and target return on risk by analyzing assets under management	**B-1.** Visualization of expected earnings for the entire portfolio through a “look-though” approach	Low	Allocation, fund selection, rebalancing, etc.	**High**	Low	Necessary	Necessary	• Cluster analysis • Pattern analysis • Text analysis, etc.
		B-2. Visualization of the risks of assets that are actually owned	Low	Allocation, fund selection, rebalancing, etc.	**High**	Low	Necessary	Necessary	• Cluster analysis • Pattern analysis, etc.
	e Visualizing tracking errors by analyzing the factors that deviate from policy asset mix	**B-3.** Controlling tracking errors by visualizing the gap between the policy asset mix and the actually owned position	Low	Quantitative evaluation of funds’ tracking errors	**High**	Low	Necessary	Necessary	• Cluster analysis, etc.
	d e Strengthening evaluation capabilities of individual funds’ performance to identity high-quality funds	**B-4.** Assisting in analyzing investment performance based on funds’ track records	**High**	Fund selection, rebalancing	**High**	Low	Necessary	Necessary	• Pattern analysis. etc.
		B-5. Advancement in fund investment evaluation and analysis	**High**	Fund selection, risk evaluation	**High**	Low	Necessary	Necessary	• Pattern analysis. etc.
		B-6. Refined abilities to grasp the risks effectively held by funds	Low	Fund evaluation, risk factor analysis	**High**	Low	Necessary	Necessary	• Cluster analysis, etc.

*Operational uniqueness: Utilization opportunities suitable for GPIF’s operational characteristics are rated “High.” Those in common with FoF operations are rated “low.”
*Information utilization sophistication: Based on the effective use of existing info, long-term forecast, and the use of indicators, opportunities that contribute to the sophistication of asset management are rated “high.”

3. Recommended Initiatives for GPIF

Overall Picture of the Use of AI for Pension Management

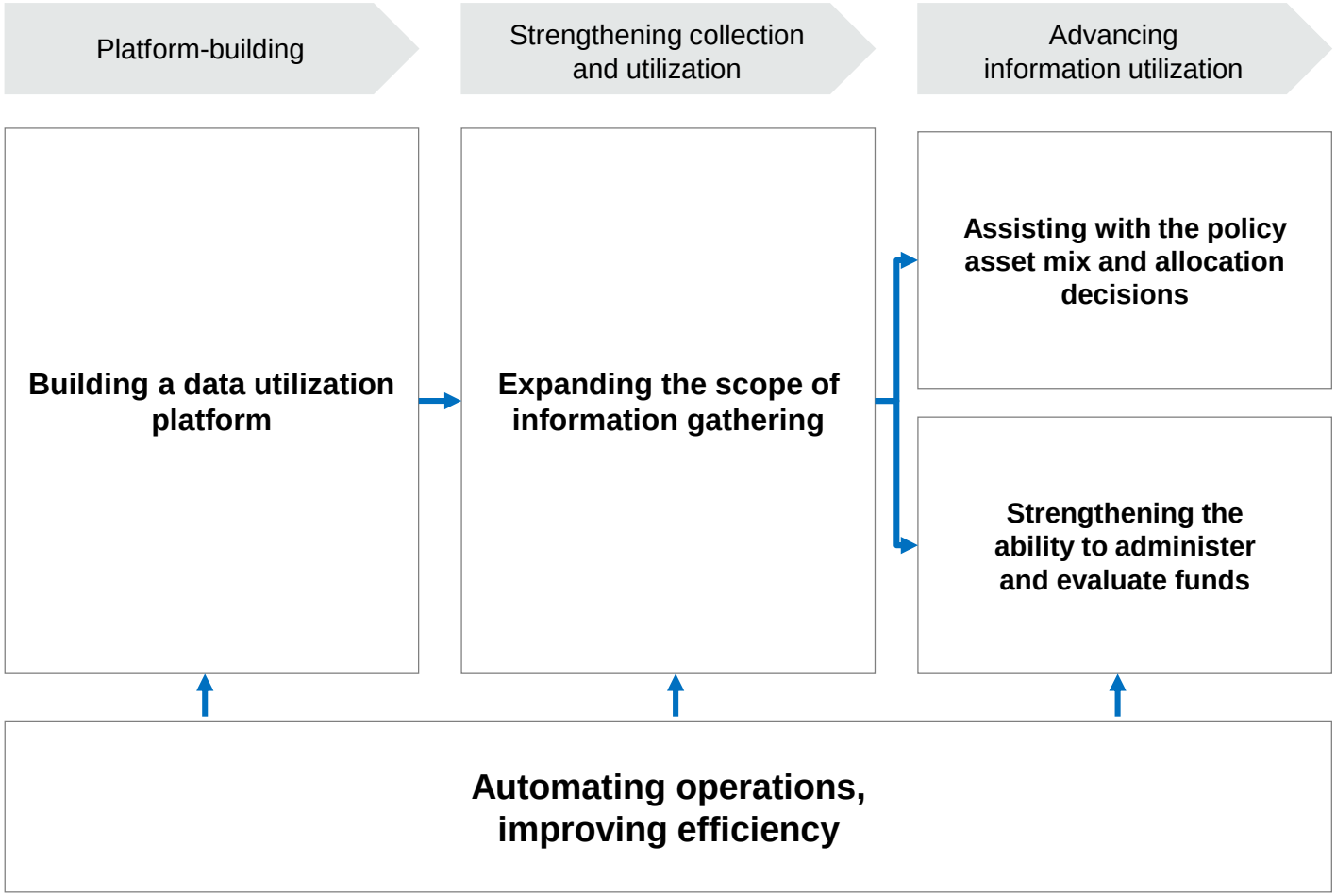
Make information entry more efficient, expand the scope of information collection, and strengthen information usage with a data sharing platform to store collected data.



3. Recommended Initiatives for GPIF

Sequence of Actual Tasks (Initiatives)

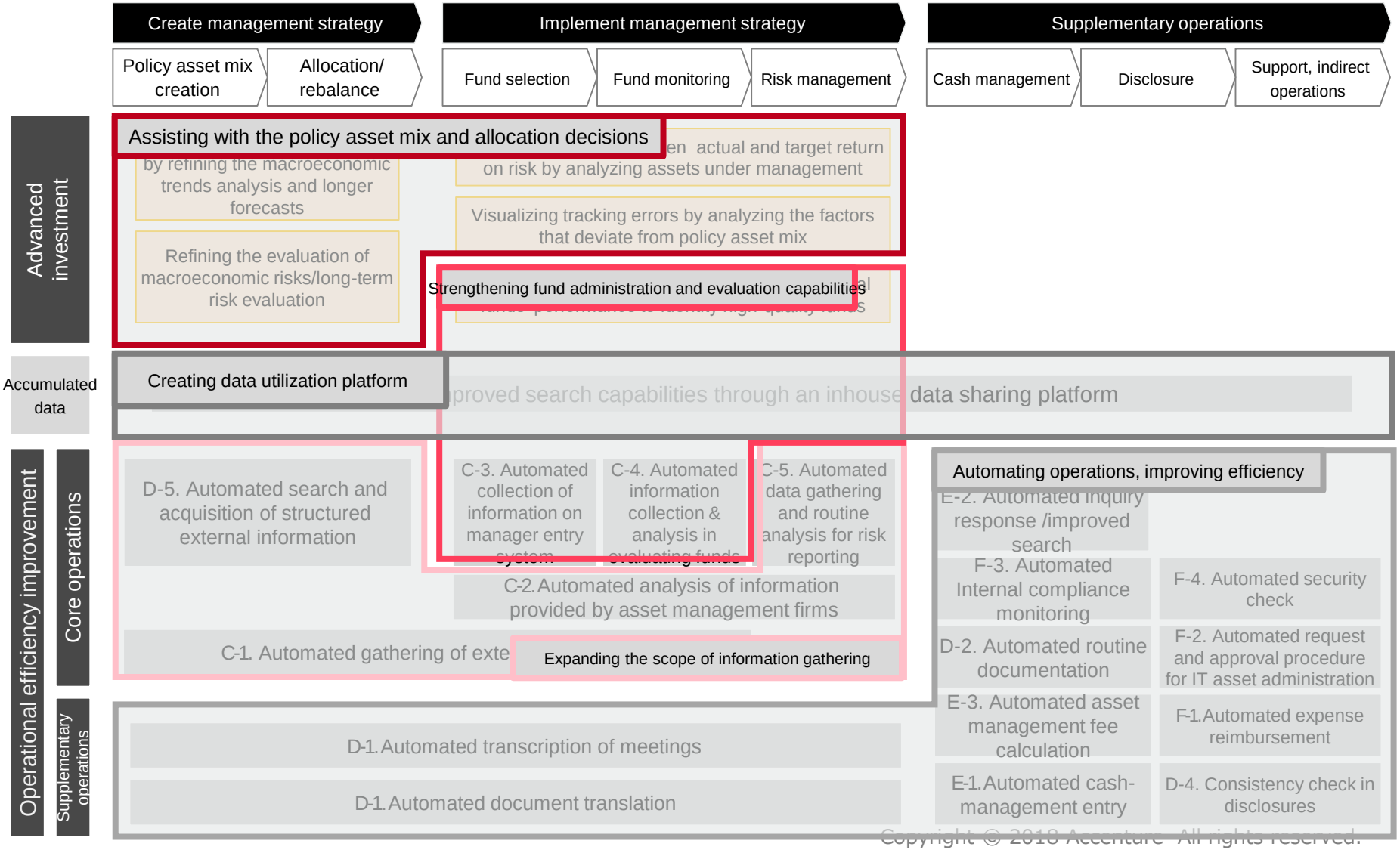
It is essential to collect a vast amount of data from asset managers and other external sources, and also to improve the capabilities of data utilization. It will be predicated on three steps: the establishment of a data platform, strengthening the ability to gather and use information, and advancing information utilization.



3. Recommended Initiatives for GPIF

Detailed Initiatives

Progress of AI utilization by five initiatives in stages.



Agenda

I. Objectives of This Research

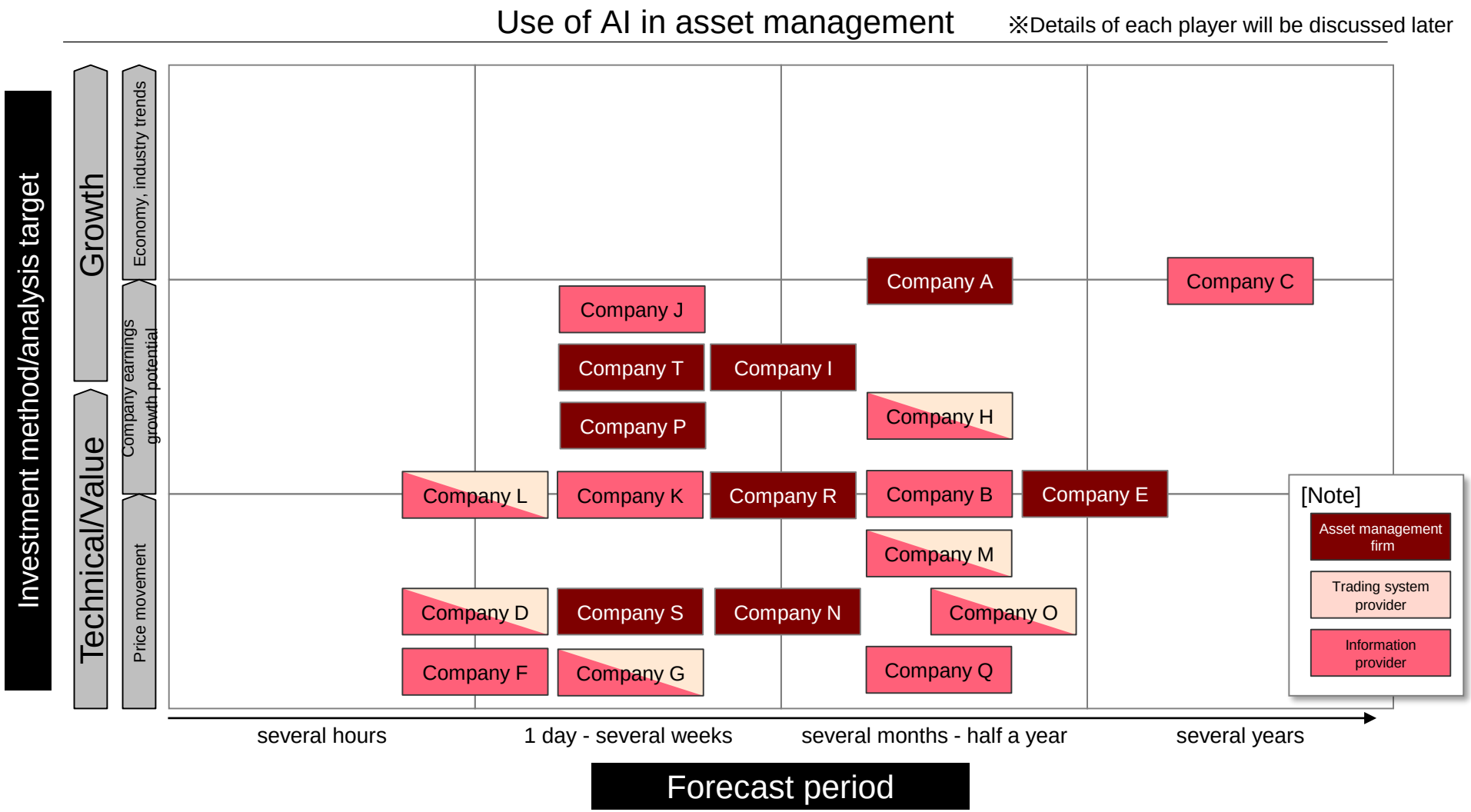
II. Opportunities to Use AI for Pension Management
  1. Approach for Using AI
  2. Opportunities to Use AI
    (1) Application for Operational Efficiency Improvement
    (2) Potential for Enhancing Asset Management
  3. Recommended Initiatives for GPIF

III. Medium- to Long-Term Development of AI

IV. Approach of GPIF

Leading Players in the Asset management Industry

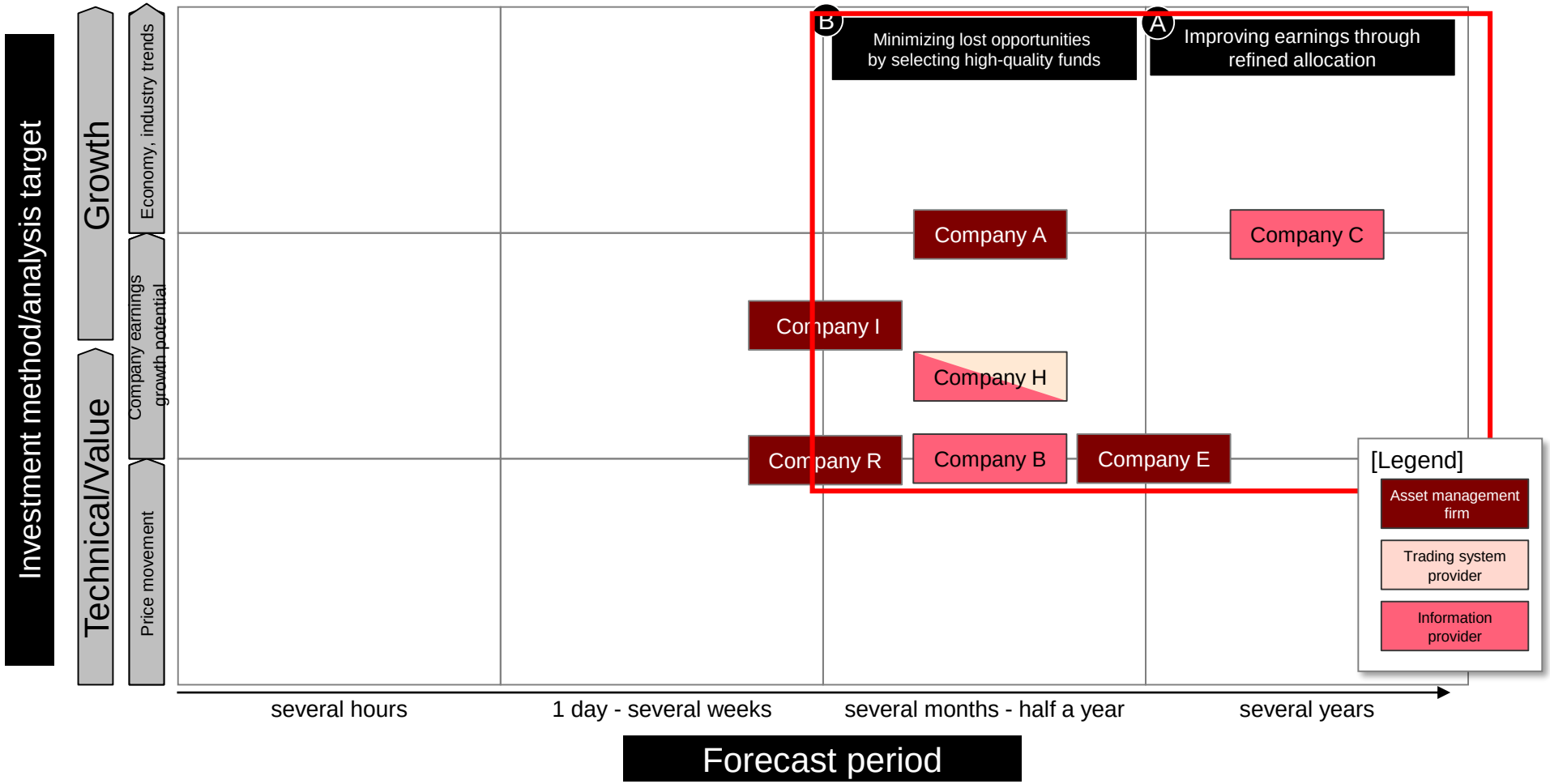
There are no AI players specializing in long-term pension management, but some providers of leading indicators and forecasts for long-term asset management and providers of fund information for contract asset management outsourcing are emerging.



Areas of Potential Use for GPIF Operations

Players that analyze corporate growth potential and economic trends on a medium- to long-term basis (at least several months) have plenty of room to use AI for long-term pension management.

Players That May Potentially Use AI for Advanced Fund Management (Example)



Case Study: Company M

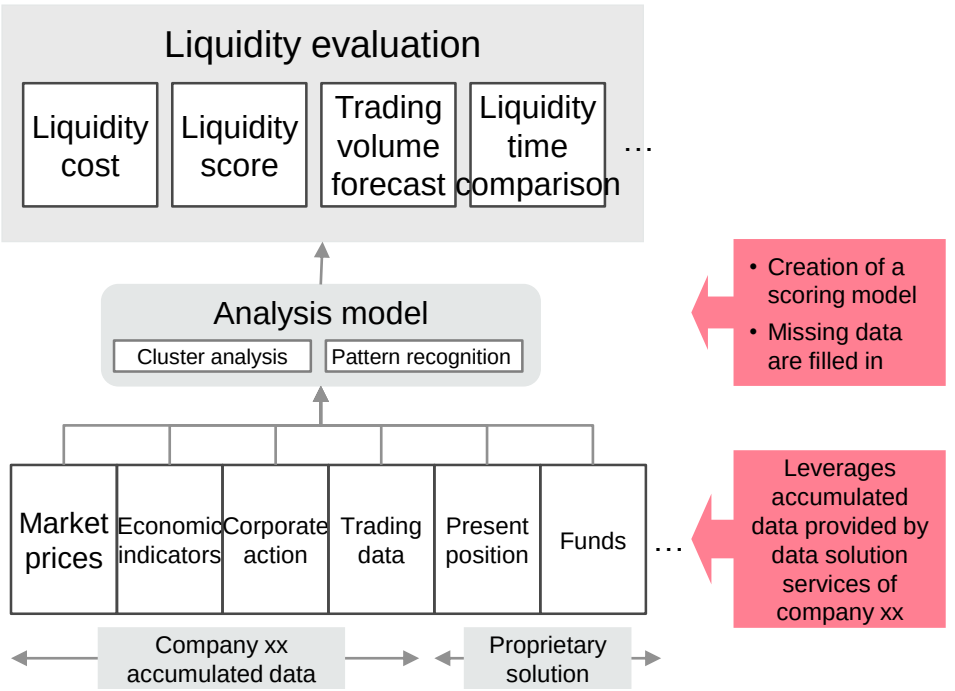
Utilizes its data and supplements incomplete trading data using cluster analysis to collect and analyze a wide variety of data to provide a more refined liquidity analysis.

Basic Information

Company (Year of establishment /headquarters)	Company M
Business	• Provision of market data. • Research services. • Solution sales（OMS).
Example	• AI liquidity risk analysis tool for financial institutions “xxxx.” • Quantifies present liquidity risks based on external data and current positions. ➢ Estimates liquidation costs ➢ Forecasts daily trading volume ➢ Relative/absolute liquidity scoring ➢ Comparison of liquidation periods across assets • These are provided as part of proprietary risk management solution services.

AI utilization

- Aggregates comprehensive data accumulated by market data and solution services.
- For incomplete data coverage, the use of cluster analysis will supplement the data to identify elements that may directly affect liquidity.



Case Study: Company C

Develops proprietary data points and utilizes leading indications to provide information useful in forecasting long-term (several years) macro trends.

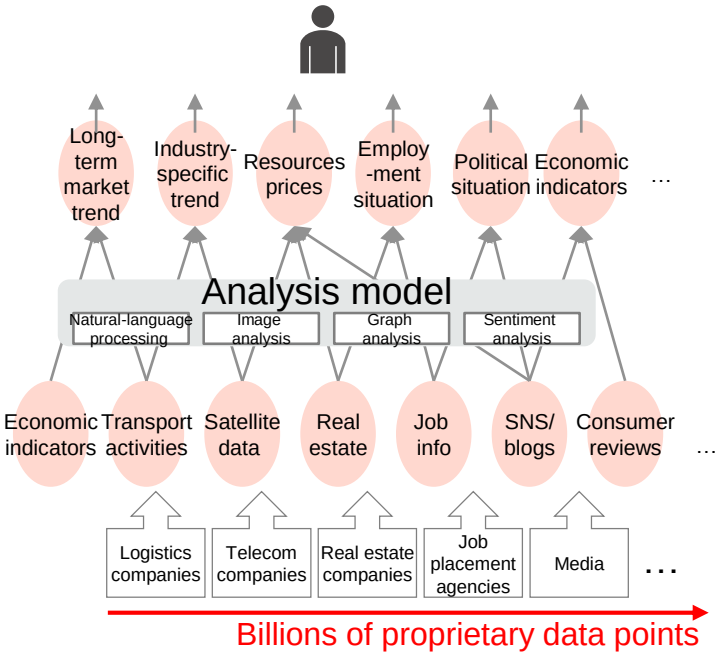
Basic Information

Company (Year of establishment /headquarters)	Company C
Business	Providing economic forecast data via AI

Example	• Provides asset management firms with input data for investment decisions.
	  • Provides economic forecasts (macroeconomic forecasts/market value forecasts).
	  • Suggests investment vehicles.
	• Revenue consists of fixed fees linked with the asset balance of management firms and variable fees linked with the asset management performance.

AI utilization

- Identifies signs of emerging trends at the early stages by using leading indicators collected from its own data points (40 countries/13 languages/ several billion data points).
- Provides data that contributes to long-term macro forecasts (such as political and economic events) and employment situations that serve as a leading indicator for inflation.



Conditions for Players with Future Potential

Players that have appropriate advanced analysis capabilities and “proprietary data points” have the potential to win the competition as AI engines.

Evolutionary theory of AI engines

- In order to mature as a business solution, AI must have an **adequate amount of data input** for both learning and analysis.
- When data acquisition costs decline and the type of available data becomes standardized , **the variety and the quality of data ensured by the proprietary data points** will directly boost the value of AI.
- Then, forecast accuracy will be required through **advanced analytical abilities.**

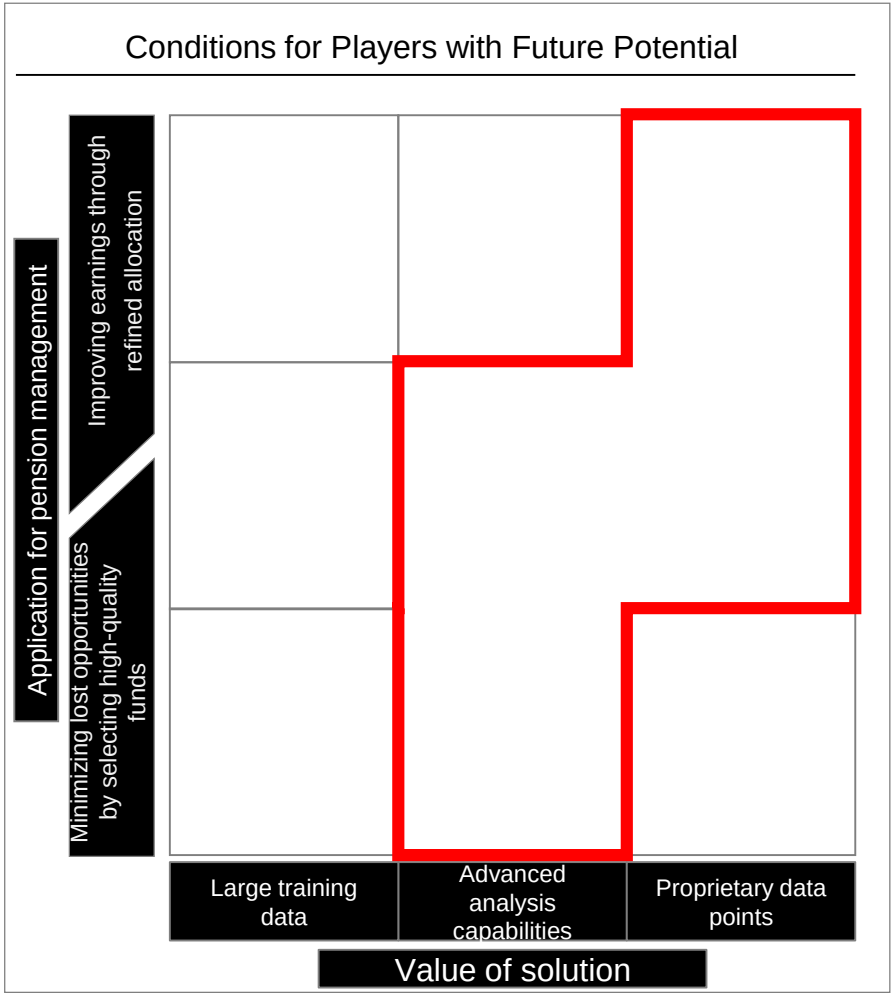
Competitive advantage in accordance with the purpose

Grasping the macro economic trends

- This is an area in which there is not enough available data for analysis. The key is to **secure data points.**

Grasping the microeconomic trends

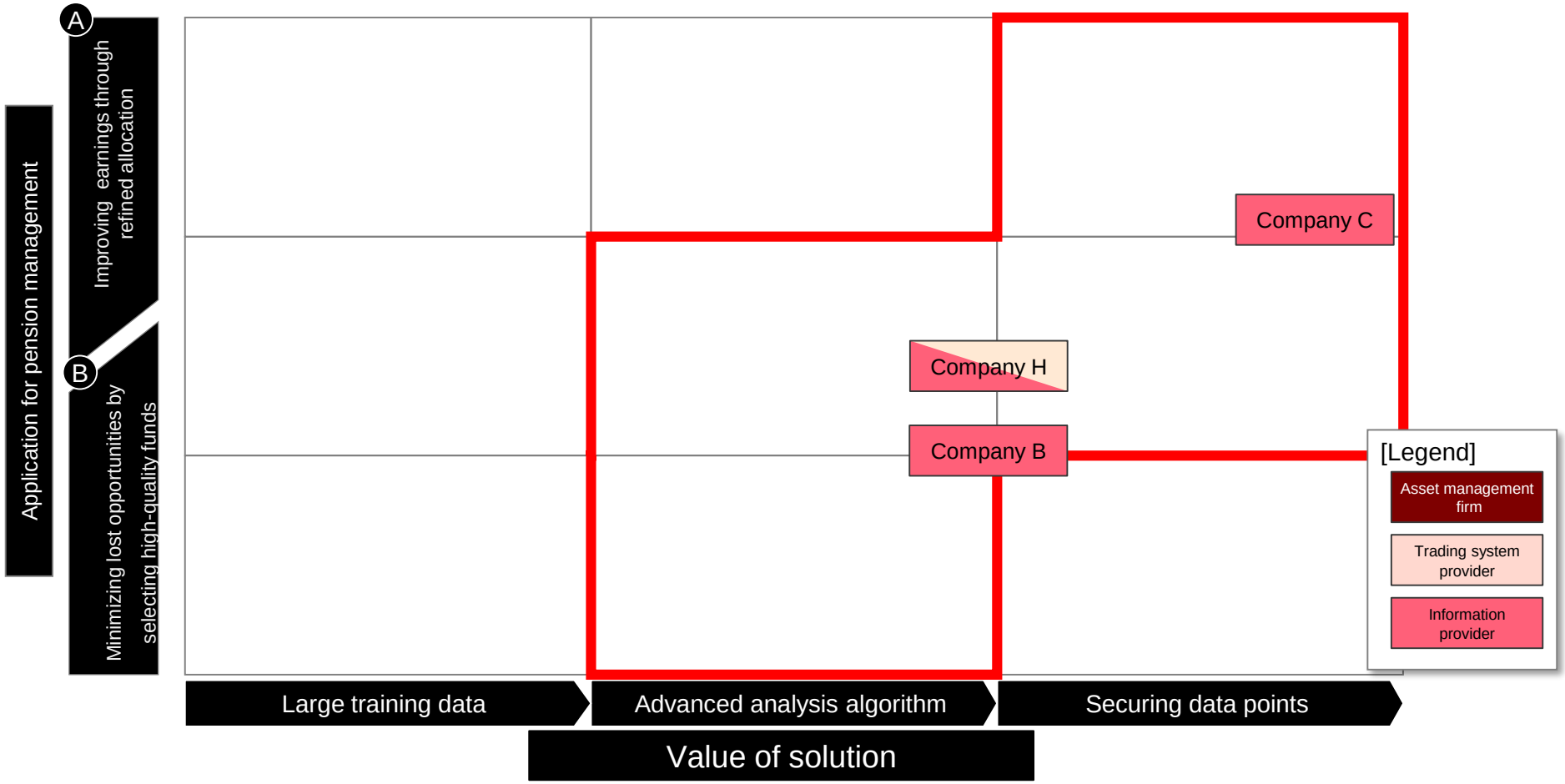
- Enough data is available for analysis, such as market data and disclosed corporate information.
- The key is differentiation with **advanced analysis capabilities.**



Partner Candidates in Medium- to Long-Term AI Development

If GPIF were to partner with any particular player, this partner must hold the potential which has been discussed in the previous page. It must also be an unbiased player not connected to any particular asset management firm.

Strategic Partner Candidates



[Reference] Overview of AI Players

Player		Management method			Forecast period			
		Price movement	Company's growth potential	Economic/ industry trends	Several hours	1 day – several weeks	Several month- half a year	Several years
A	Manages hedge funds using AI. Analyzes big data such as economic indicators, macroeconomic, microeconomic data, corporate financial data, weather information, news, SNS, etc.		○	○			↔	
B	Uses big data to analyze the stock market's response to past major events, such as weather, elections, war, natural disasters.	○				↔		
C	Provides market forecast services focusing on macroeconomic trends, stocks, and commodities. Maintains billions of data points to track leading indicators, developments in the real economy, and other phenomena that may impact the economy, in a quick and comprehensive manner.		○	○		↔	↔	↔
D	Provides a quantitative trading system with AI.	○			↔	↔		
E	Manages hedge funds using an AI that learns the fund managers' thinking pattern and mimics their decisions.	○	○				↔	↔
F	Automatically designs the user's trading strategy with deep learning. It can detect a pattern similar to currency exchange charts since 2001 by deep-learning images.	○			↔	↔		
G	Provides solutions to designs and adjust portfolios in response to changes in the market.	○				↔	↔	
H	Provides portfolio management support services for hedge funds and PEs.		○				↔	↔
I	Manages hedge funds using AI, which learns the employees' trading decisions and the outcome. The learning is used for risk, pricing, and timing calculations.		○			↔	↔	↔
J	Uses cloud intelligence and AI to extract information on investment decisions and provides it real time. Analyzes financial news and processing data.		○			↔	↔	

[Reference] Overview of AI Players

Player		Management method			Forecast period			
		Price movement	Company's growth potential	Economic/ industry trends	Several hours	1 day – several weeks	Several month- half a year	Several years
K	Provides data to assist in analytics, big data analysis, monitoring, scenario analysis based on pattern analysis for hedge funds.	○	○			↔		
L	Provides market forecast alerts every several hours or days. Predictive analytic tool for investment banks and asset managers.	○	○		↔	↔		
M	Provides a liquidity risk assessment tool for investors and financial institutions. Scores liquidity risks based on market prices, indicators, and the actual positions.	○				↔		
N	Provides an investor platform to detect and advise on sudden decreases in the value of portfolios based on indicators, market data and news.	○			↔	↔		
O	Adopts market and liquidity risk evaluation functions as part of an EMS package that it provides. Uses corporate financial data and economic indicators to conduct regression analysis to provide risk quantification analysis based on its own model.	○					↔	
P	Manages funds using AI. Uses statistical software and techniques which continuously learn and which were developed through machine learning.		○			↔		
Q	Forecasts market developments through big data analysis.	○					↔	
R	Manages hedge funds using AI. Selects securities through deep analysis of comprehensive data such as economic indicators, economic and political information, financial data and market sentiments.	○	○			↔	↔	
S	Detects factors that may affect stock prices through machine learning, using economic indicators and market data to make investment decisions.	○				↔		
T	Manages funds using AI. Identifies market patterns by analyzing market developments and economic indicators and proposes investment strategies using a model build through deep learning.		○			↔		

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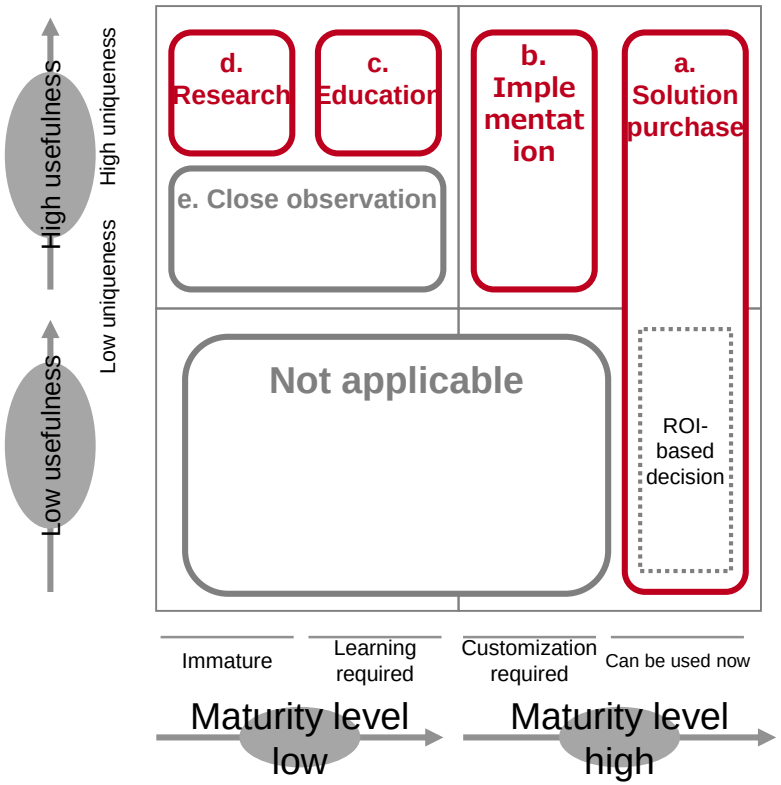
Options in Introducing AI

The introduction load is different according to technical maturity. In order for GPIF to preferentially invest its resources in areas where it has unique capabilities, it is essential that the focus be placed on unique domains in regards to areas of low maturity.

GPIF's initiatives

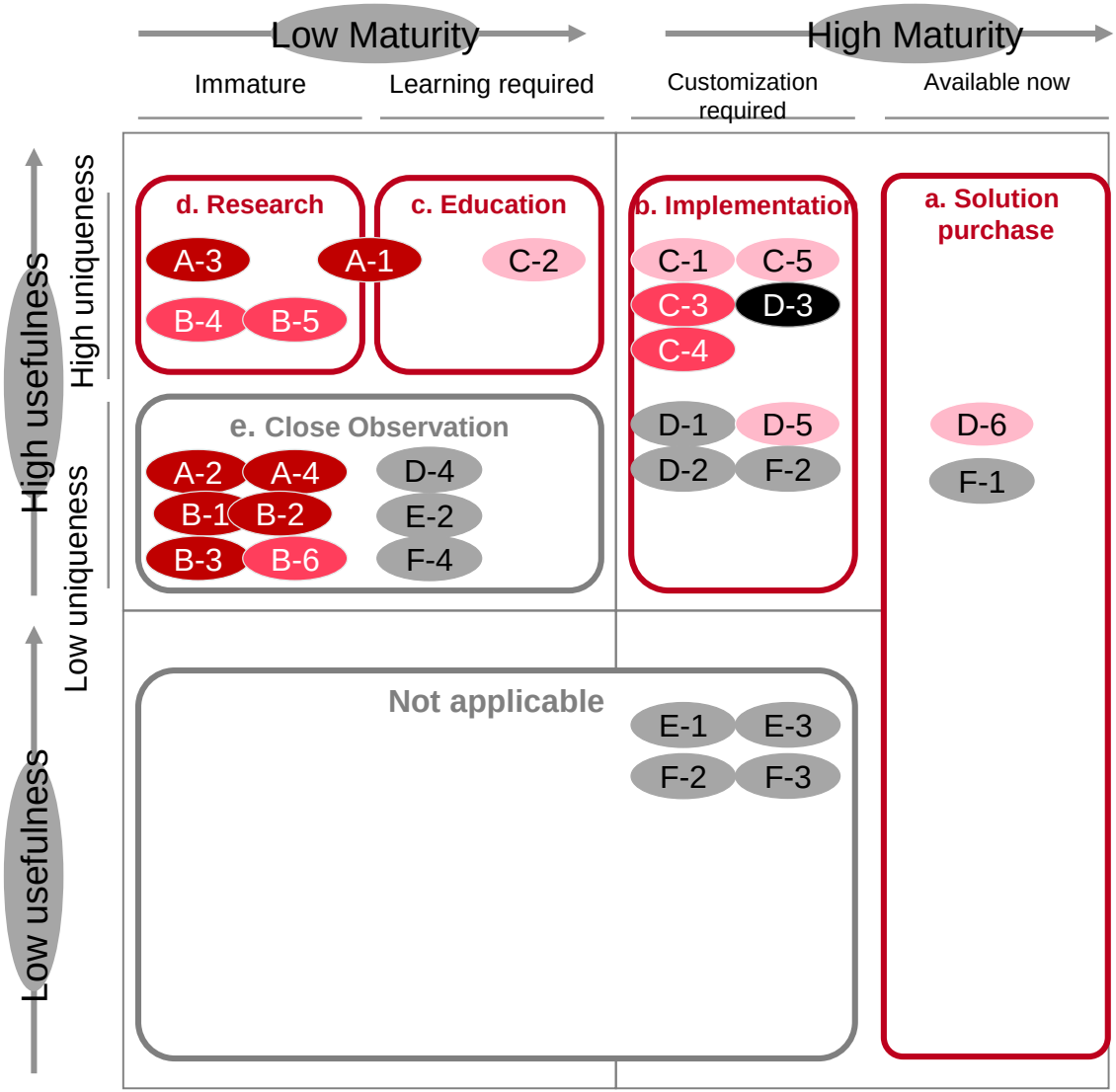


- AI is a technology that is still at the development stage. It is necessary to carefully monitor the progress of its maturity in areas where GPIF does not have unique capabilities, rather than rushing to adopt the technology in such areas.
- However, for areas where GPIF has unique capabilities and where the utility is high, it should consider proactively engaging in development by carrying out research.

a. Solution purchase	Available as a business solution. It can be adopted with a slight adjustment in parameters.
b. Implementation	Available as a business solution. It requires development tailored to the user's business.
c. Education	Commercialized as an elemental technology. It needs to learn the user's own rules. It must be used in combination with other similar products
d. Research	The elemental technology exists, but commercialization has not been achieved. More R&D is necessary.
e. Carefully watched	Carefully watch the situation. Do not proactively adopt it. Consider acquisition when it matures.

Priority in Use Case

Based on the criteria described in the previous page,
16 use cases should be prioritized.



[Legend] Initiative

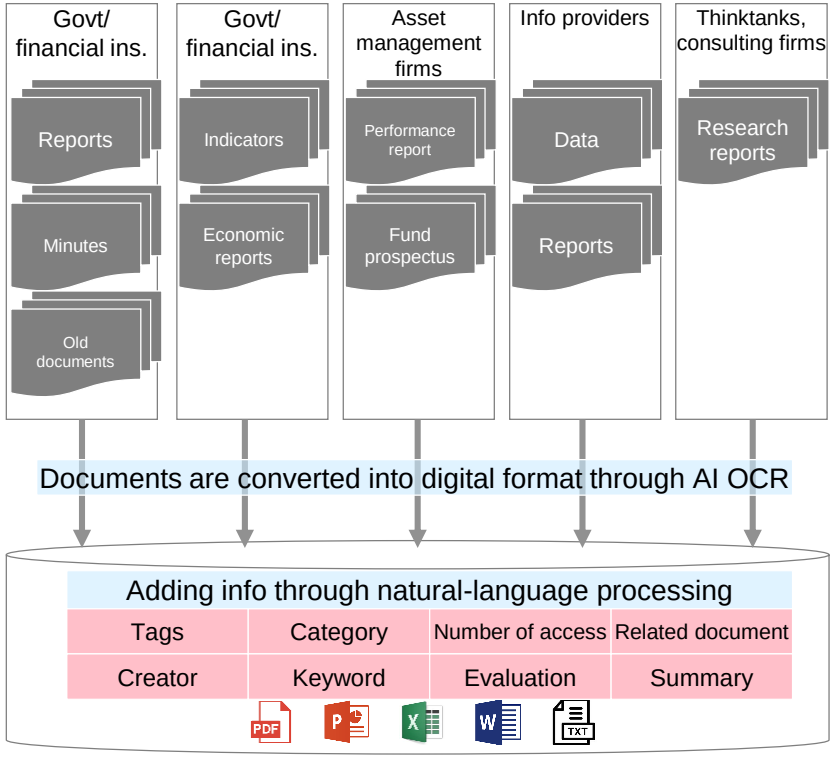
- Building a data utilization platform
- Expanding the scope of information gathering
- Strengthening the ability to administer and evaluate funds
- Assisting with the policy asset mix and allocation decisions
- Automating operations, improving efficiency

C-1. Automated gathering of external information
C-2. Automated analysis of information provided by asset management firms
C-3. Automated collection of information on manager entry system
C-4. Automated information collection, automated analysis in evaluating funds
C-5. Automated data gathering and routine analysis for risk reporting
D-1. Automated transcription of meetings
D-2. Automated routine documentation
D-3. Improved search capabilities through an inhouse data sharing platform
D-4. Related information search and consistency checks disclosing information
D-5. Automated search and acquisition of structured external information
D-6. Automated document translation
E-1. Automated cash management entry
E-2. Automated response to inquiries and improved search capabilities of bylaws
E-3. Automated calculation of asset management fees
F-1. Automated expense reimbursement
F-2. Automated request and approval procedure for IT-asset administration
F-3. Automated Internal compliance monitoring
F-4. Automated security check for firms under contract
A-1. Refined management goal-setting based on leading indicators
A-2. Optimization of allocation by the refinement of economic forecast calculation
A-3. Refined risk evaluation based on leading indicators
A-4. Subdivision of risk evaluation
B-1. Visualization of cross-portfolio expected performance with look-through
B-2. Visualization of the risks of assets that are actually owned using look-through
B-3. Curtailing tracking errors by visualizing the gap between target and actual port.
B-4. Assisting in analyzing management performance based on funds' track records
B-5. Advancement in fund investment evaluation and analysis
B-6. Refined abilities to grasp the risks effectively held by banks

Initiatives in Detail: Creating Data Utilization Platform

Build a platform to organize and utilize a vast amount of information. Accumulate and utilize information that is being buried.

Overview



- Various search methods, such as those using keywords and tags.
- Makes recommendations based on user preferences.

- Adds data.
- Evaluates recommendations.

- Manage data in **various formats** in a uniform manner.
- Rather than managing data through the conventional folder hierarchy, add info such as tags and document categories that are **suitable for data search.**
- Content can be **searched across documents.**
- Users will provide evaluations, creating **shared knowledge.**

Application approach

Technical maturity

High	Medium	Low

Elementary technology	Elementary technology maturity
① Database	High / Medium / Low
② Morphological analysis	High / Medium / Low
③ Text mining	High / Medium / Low
④ AI OCR	High / Medium / Low
⑤ Machine learning (Grasping preferences)	High / Medium / Low

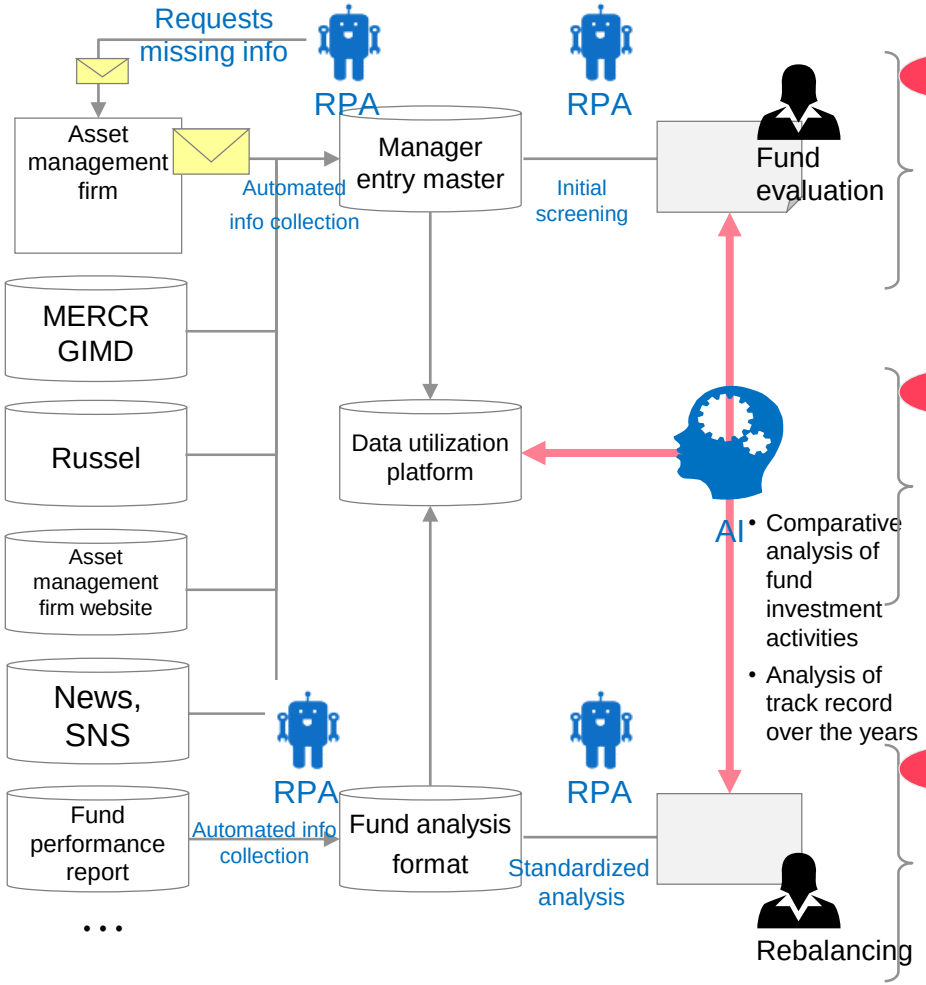
Barriers to introduction

- Watson Explore and other solutions already exist, but customization is necessary in accordance with the user's business.
- A certain period of learning is necessary to improve search accuracy.

Initiatives in Detail: Strengthening Fund Administration and Evaluation Capabilities

Improve the capabilities to search the information provided by funds, convert information that is not being fully utilized into a format that can be analyzed, and develop GPIF's own analysis methods and evaluation models to upgrade evaluations.

Overview



C-3

- Automate the operations for manger entry system to allow for evaluation of a wider variety of funds at a deeper level.

B-4 **B-5**

- Conduct analysis over time and comparative analysis of different funds to evaluate funds' performance more objectively and comprehensively.
  - Comparative analysis of fund investment activities
  - Analysis of track record over the years

C-4

- Improve efficiency by automating standardized analysis on fund performance reports.

Application approach

Technology maturity

High	Medium	Low

Elementary technology	Elementary technology maturity
① RPA	**High** / Medium / Low
② Text mining	**High** / Medium / Low
③ Machine learning	High / **Medium** / Low

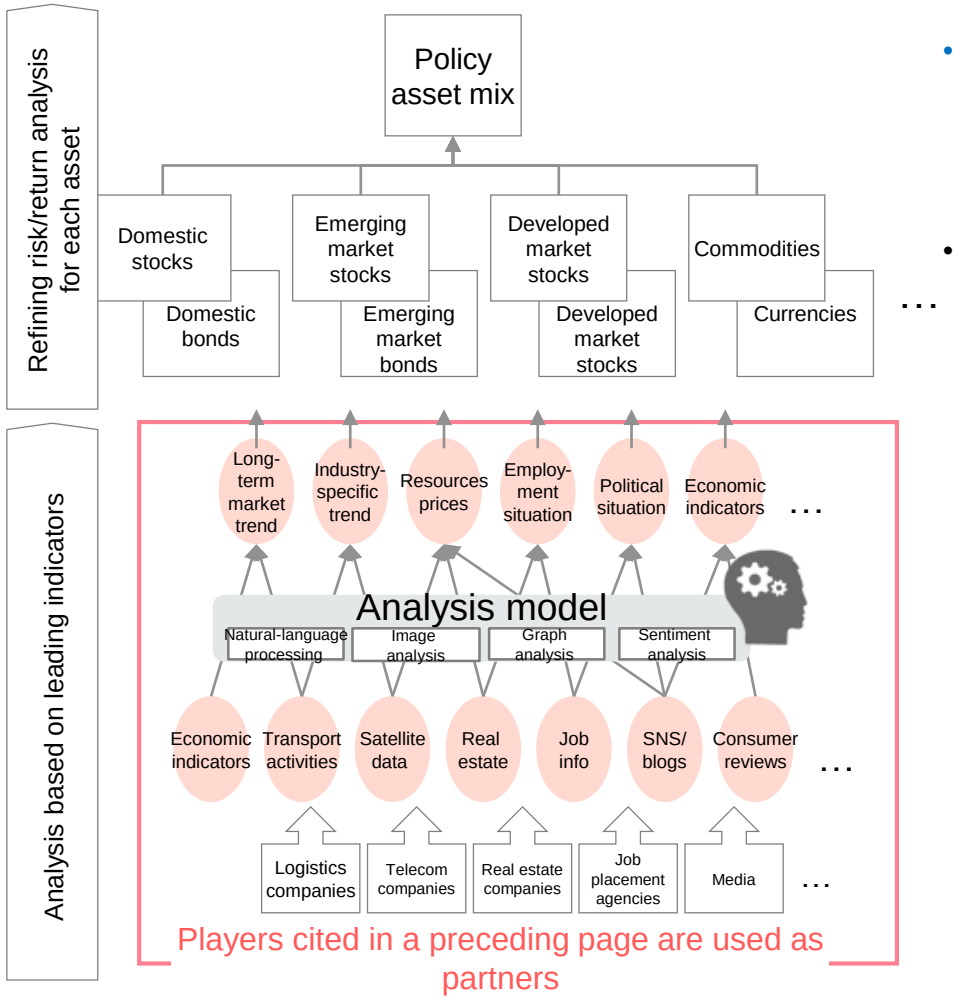
Barriers to introduction

- Installation processes (such as script creation in accordance with the current operations) will be necessary for RPA.
- An analysis viewpoint must be determined and analysis rules must be defined to use AI fund analysis. A learning process is also required.

Initiatives details: Assisting with Policy Asset Mix and Allocation Decision

It is becoming possible to evaluate expected returns and risks for each asset faster and more accurate by utilizing the trend of real economy, which serves as leading indicators, as input rather than conventional lagging indicators.

Overview



- **Leading indicators** allow for early identification of performance/ upside and downside factors.
- The policy asset mix can be optimized for each asset by adjusting the expected return and risks as necessary.

Application approach

Technology maturity

High	Medium	Low

Elementary technology	Elementary technology maturity
① Natural-language processing	Medium
② Image analysis	Medium
③ Graph analysis	Medium
④ Machine learning	Medium
⑤ Deep learning	Medium

Barriers to introduction

- There are no solutions available for domestic, long-term asset management. Thus, collaboration is necessary with overseas players.

