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Method for Identifying Business Goals and Tasks for AI Service Systems

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Abstract

In this study, we considered projects in which enterprise service systems are developed using artificial intelligence (AI) technologies. Many enterprises have started applying AI technologies to their business functions. When effectively introducing AI technologies, it is important to identify suitable business domains in the enterprise before planning the projects. For this purpose, we propose a GQM+Strategies-based method that divides the top business goal into strategies as part of a goals-strategies decomposition tree, and identify the business goals and tasks for AI service systems. In addition, we propose a method for assessing the applicability of an AI service system for the identified business tasks. We confirm the effectiveness of the proposed methods through a real-world business analysis and a use case analysis.

Keywords: AI service system, GQM+Strategies, Business task modeling, Enterprise architecture

1 Introduction

Many machine learning (ML) based AI programming modules available as application programming interfaces (APIs) enable AI technologies to be utilized for practical business applications. Under this situation, enterprises have started to apply AI technologies to support inquiry service operators when responding to queries regarding business operations, products, or services, and managing screening operations that use documents containing many types of client data, among other factors. In this paper, we consider system development projects for enterprise support activities using AI technology APIs. When applying AI technologies to these business functions, training data on the target business domain must be acquired. This means that knowledge of, or experience in, the target business domain is essential. Therefore, representatives of the relevant business division are required to participate in a project alongside those of the IT division and must have a common understanding of the project.

Projects encounter numerous points of contention and technical challenges when AI service systems are being developed[3]. It is believed that there are nine reasons why machine-learning projects fail [1]. Among the nine reasons given, the following are project management related issues.

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[1] https://www.kdnuggets.com/2018/07/why-machine-learning-project-fail.html

1. Asking the wrong questions
2. Trying to use AI technologies to solve the wrong problems
3. Not having suitable data

These issues can be solved during the project planning phase if we assess which business in a company that that AI technologies can be applied to and how such technologies will be used by practitioners. This assessment can be conducted effectively if data scientists collaborate with project members from the business division. However, in many cases, data scientists cannot be expected to be involved in the project planning stage because of limited human resources.

Under this situation, practitioners in a business division are required to identify the domain in their business for which the AI technologies should be used and assess whether we can apply the AI technologies to the business tasks in the domain effectively at the project planning stage. For this purpose, in this paper, we first propose a business analysis method based on GQM-Strategies[5] to enable practitioners in a business division identify a suitable AI-applicable domain. Second, we propose a method for effectively assessing the applicability of AI service systems without the support of data scientists with deep knowledge regarding AI technologies. We then confirm the effectiveness of these proposed methods through their application in an actual business.

The remainder of this paper is structured as follows. In Section 2, related studies are described. In Section 3, we introduce the AI service system and define the research hypothesis of this study. In Section 4, we describe our proposed business analysis methods. In Section 5, we describe the experiment conducted to test how the proposed methods are applied to actual business cases. Finally, we discuss the results of the experiment in Section 6, and summarize the key points and future studies in Section 7.

2 Related Work

Projects that implement big data analytics or machine-learning technologies require a representation of the system architecture in which a solution is operated[8]. Appropriate structuring of development teams has also been proposed[7][10]. However, such analysis should be conducted only once the applicability of the technologies within the target business domain has been confirmed.

Business-IT alignment is being introduced into enterprise systems management. Organizational business-IT alignment defines the processes and objectives by which business and IT functions are to be integrated. This approach decreases the organizational uncertainty and improves the agility of the enterprise. Methods for constructing a business-IT alignment model using an enterprise architecture (EA) approach were introduced in [11][16]. For an AI service system development project, an EA-based business-IT alignment model was proposed [18]. However, this modeling approach assumes that AI technologies are suited to the target business domain, and therefore the applicability of AI technologies is not reviewed.

For designing ML-based AI service systems, some canvas models extended from the business canvas model [15] are proposed [1][14]. In these canvas models for AI service systems, the final business goal to be achieved and the actions based on the prediction by AI service systems will be described in the canvas cell respectively. However, any detailed methods for filling each cell in these canvas models are not proposed. For analyzing the applicability of AI technologies, three types for AI service systems are proposed in [6].

However, it is not clear how we identify the correct AI service system type for a given business goal.

Research has been conducted on a generic process for developing a system to implement machine-learning technologies[3], and the roles of data scientists in various projects [12] have been discussed. In this research, although the applicability assessment of machine-learning technologies in the target business domain is regarded as a process during the model-selection phase, practical assessment methods are not discussed.

3 Subject of Research and Research Hypothesis

3.1 AI Service System

In this study, we use ArchiMate[19] as an EA modeling language. To represent a project for developing a system using AI technologies, we use the following three business concepts and three application concepts defined in ArchiMate:

- Business service: This is an explicitly defined exposed business behavior.
- Business process: This is a sequence of business behaviors achieving a specific outcome.
- Business object: This is a concept used within a particular business domain.
- Application service: This is an explicitly defined exposed application behavior.
- Application component: This is an encapsulation of application functionality aligned to the implementation structure.
- Data object: This is a data structured for automated processing.

Through this EA modeling approach, we represent a practical AI service system project in which we develop a system containing AI technologies for an enterprise function. In an office, employees conduct various intelligent activities. There are three types of human intelligence: analytical, creative, and practical[17]. In our study, we consider the development of a system with analytical intelligence for offices that supports or substitutes human activities.

Analytical intelligence selects an optimal option from predefined options as output for the given input data[17]. In an office, this intelligence is used in daily activities, such as inquiry services for service queries or business assessments based on documents. We can use machine-learning technologies when we realize this intelligence as a software system. To use machine-learning technology for system development, we need to define options in the target business domain and collect example inputs assumed for each option. A machine-learning model is generated (Training) from training data containing such pairs of options and examples. This model is deployed into a runtime machine-learning engine, which obtains input data and provides output data using the model (Prediction). This system, called the AI service system, is illustrated using the EA modeling approach in Figure 1.

3.2 Research Hypothesis

In this study, we consider the projects developing AI service systems in enterprises for their business functions. When applying AI technologies to business functions, we need

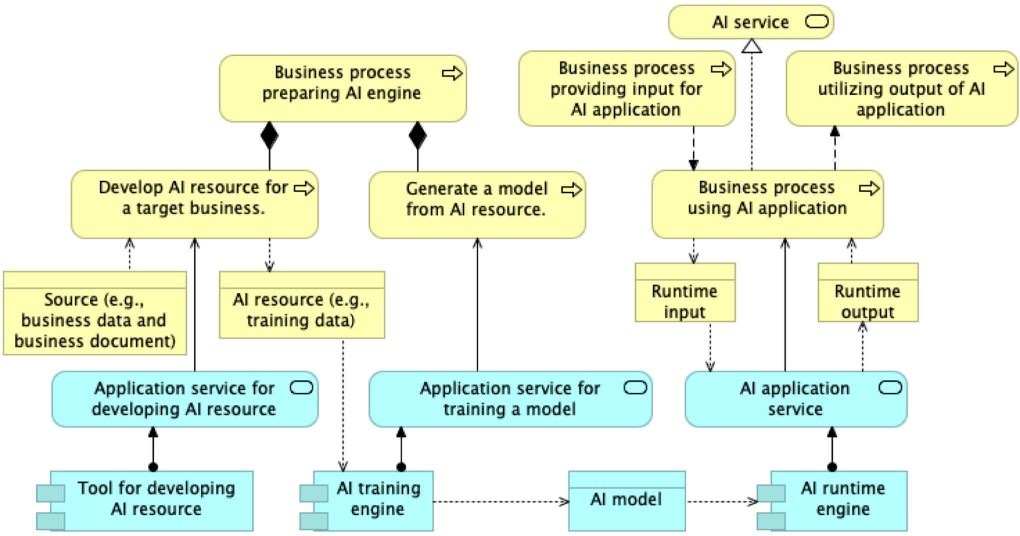

Figure 1: AI service system represented by ArchiMate

to identify suitable business domains where such technologies can work effectively from the business perspectives. This means that we should identify a suitable business process using the AI application shown in Figure 1. Although we need to identify the business goals for the AI service design before planning the project, practitioners in the business division understand their business functions but do not have sufficient knowledge regarding the technologies. In addition, data scientists understand the technologies but do not have sufficient knowledge on the business division, and we cannot expect their support for identifying business goals from the technical viewpoints at such an early stage in the project owing to limited resources.

For such a situation, we consider the following research question (RQ).

RQ Can we identify the business tasks where AI technologies can be applied effectively without sufficient support form data scientists?

For this RQ, we propose a business analysis method to enable practitioners in the business division to identify the business goals for AI service. In addition, we propose a method to assess the viability of AI service systems to the identified candidate business tasks. By applying the proposed method to a business domain, we confirm the following:

- Business goals achieved by an AI service system can be identified in a real business.
- Practitioners in a business division can assess the applicability of AI service systems effectively without support of data scientists.

4 Proposed Business Analysis Method

4.1 Overview

The enterprise functions considered in this research are divided into business tasks, and practitioners are assigned to each task. We propose following two methods:

- A method for identifying business goals for AI service systems in an enterprise.
- A method for assessing the applicability of AI service systems for business tasks.

4.2 Identifying Business Goals for AI Service Systems

To identify suitable business goals for new AI services in an enterprises, we propose a method based on GQM+Strategies [5], which provides concepts and actionable steps to create links between goals and strategies across an organization and enables measurement-based decision-making. With this method, we use the goals-strategies decomposition for our analysis. With GQM+Strategies, a goal and strategy are defined as a status that will be achieved in the future and an approach to achieve the goal, respectively. For the decomposition, we set a top goal as the first step and attempt to find approaches that achieve the top goal as a strategy. To confirm whether each approach can be conducted appropriately, we assign a goal to each strategy as a sub-goal. For each sub-goal, we attempt to find strategies again. We repeat these analysis steps until we can no longer divide the goals further into strategies.

As a result, we can obtain a goals-strategies decomposition tree. The modeling of corporate strategies is considered in[2]. On the basis of this model, we represent our goals-strategies decomposition tree by applying ArchiMate, as shown in Figure 2. For each terminal strategy in the decomposition tree, we can identify the corresponding business task.

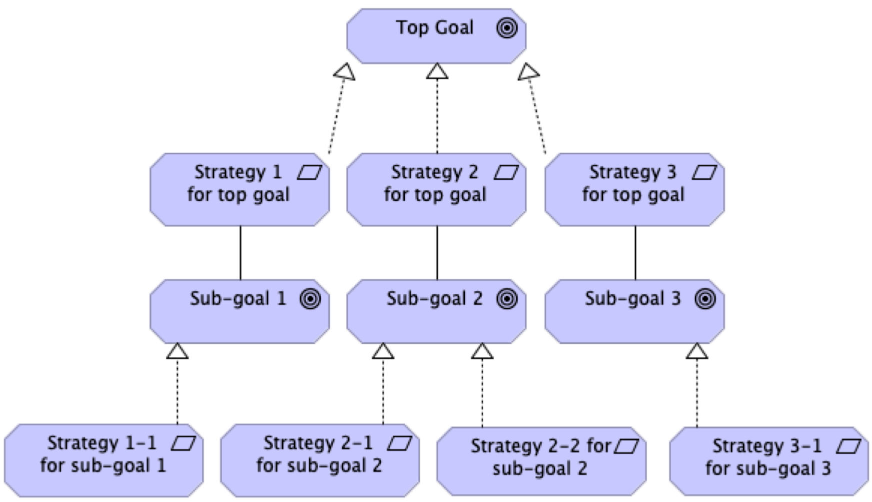

Figure 2: Goal-strategies decomposition

As mentioned in Section 2, there are canvas models for designing AI service systems [1][14]. Though the final business goal to be achieved and the actions based on the prediction by the systems should be described in these models, any methods for identified these items for AI service systems are not proposed. Therefore, it is expected that we can apply this method for developing the canvas models for AI service systems.

In the next section, we assess whether we can effectively apply AI technologies to the identified business task.

4.3 Business Task Assessment for AI Service Systems

Herein, we consider a method for assessing the applicability of AI service systems for business tasks. We examine projects where AI technologies execute functions in an existing enterprise and construct a model to identify the features that a host business should have. We also identify the pre-conditions that the AI service system should satisfy. Next, we propose that these features and pre-conditions be used as assessment indexes for the applicability of AI technologies to a service system.

The Observing, Orienting, Deciding, Acting (OODA) model was proposed by Boyd as a basis for the decision-making process. This model illustrates that the human decision-making processes consist of the following four steps[4]:

- Observing the facts by capturing relevant data regarding the environment.
- Orienting the human participants to the information derived from the facts by applying knowledge.
- Deciding on the directives based on the operational hypothesis.
- Acting on the directives and producing outcomes.

By using the OODA model and ArchiMate, a business task is described as shown in Figure 3. In this model, each step is defined as a business process and the inputs and outputs of

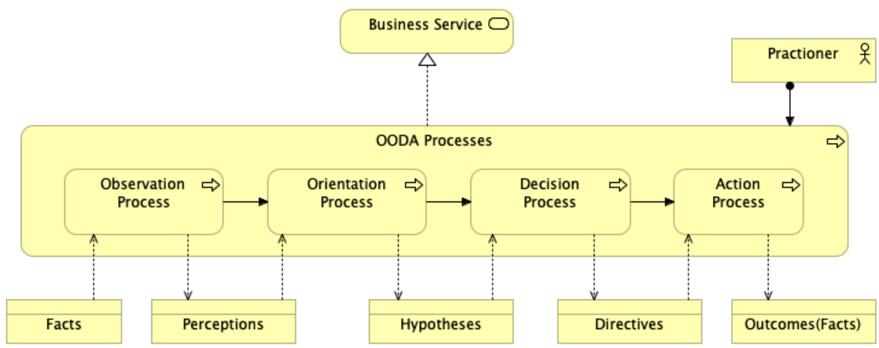

Figure 3: Business task represented by the OODA model

each step are listed as business objects. The definitions of the business objects are listed in Table 1.

When applying AI technologies to actual enterprise functions derived from the model shown in Figure 3, we conclude that enterprise functions have the features listed below.

- **C1:** The OODA model can represent a business task as an enterprise function despite no feedback loop to the previous steps.

Table 1: Business objects in the business task model

Business Object	Definition
Facts	Inputs of the business task
Perceptions	Extracted and converted data just required for the business task
Hypotheses	Structured information for the objective of the business task
Directives	Candidates of the options for the action
Outcomes	Outputs of the business task (inputs for the next business task)

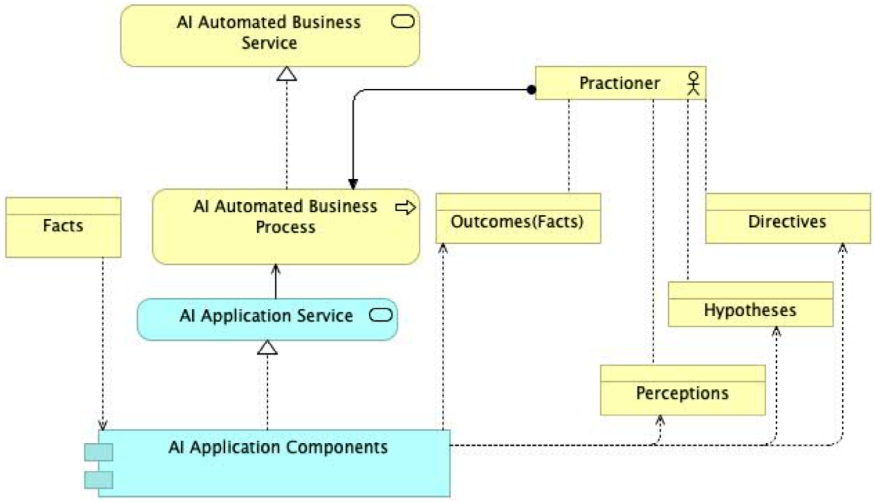

Figure 4: AI service system used in the OODA process

- **C2:** The input format (Facts) of the business task should be standardized.
- **C3:** The ratio of the time required for the completion of the OOD steps relative to the entire business task is high.

C1 indicates that the practitioners must request additional inputs or consult with their managers if they cannot execute the task. C2 indicates that when the task requires inputs, the input format or data type (e.g., voice and text) should be standardized. C3 indicates that the OOD steps depend on the skills and experiences of the practitioners.

Under these circumstances, the introduction of an AI service to (semi-)automate the task can be considered. An AI application for the task represented in the OODA model is shown in Figure 4. The practitioners execute a business task by referring to the outcomes from the AI application components. They can also refer to the intermediate outputs (perceptions, hypotheses, or directives) if necessary. From the model shown in Figure 4, we observe that when the following conditions are satisfied, an AI application service can be used effectively to finalize a task.

- **C4:** Practitioners can complete the business task by referring to intermediate outputs when the results of the AI application components are unreliable.

Table 2: Data objects for the AI application components

Data Object	Definition
Transformation Model	Model for extracting and converting data required for the task from the original data
Assessment Model	Model for constructing the structured information specific for the task
Resolution Model	Model for identifying the output options from a large list of candidates
Enactment Model	Model for determining the final output

- **C5:** Practitioners can complete the business task even when some of the outputs are unreliable.

There are steps that involve practitioners even when automation is in place. In such steps, the practitioners confirm the outcomes and proceed to execute the next task for which they are responsible. For this reason, we consider C4 and C5 to be essential when implementing an AI application service.

Next, we consider AI application components for implementing an AI application service. It is assumed that most of the business functions in an enterprise are knowledge-intensive tasks. A model representing the Knowledge Intensive Data-processing System (KIDS) is proposed in [9]. In this model, KIDS consists of the following four components:

- Transformation component: Data required for the business task are extracted and converted.
- Assessment component: Information is structured according to the objectives of the business task.
- Resolution component: From the structured information, possible options are found for the outcomes of the business task.
- Enactment component: The outcomes of the possible options are determined based on the task-specific preconditions.

This KIDS model is represented using an ArchiMate visualization, as shown in Figure 5. Each application component links to the model of a specific function, and these models are

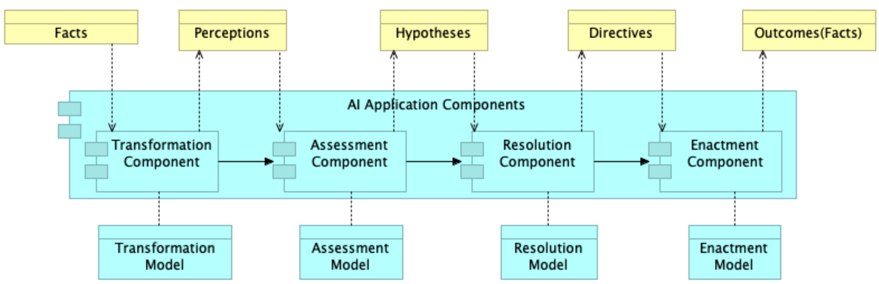

Figure 5: AI application components and data objects

represented as data objects. The definitions of the data objects are shown in Table 2.

To implement these AI application components, using machine-learning, business rule management systems, or logic programming, we conclude that the following conditions should be satisfied.

- **C6:** The transformation component integrates with a general model. (The model can be updated to improve the performance.)
- **C7:** The schema of the task-specific structured information can be explicitly defined and there are sufficient data available for constructing the assessment model.
- **C8:** The data represent all options required to execute the specified business task.
- **C9:** There is an explicit rule used to finalize the last output of the selected options.

C6 indicates that we can use existing extract, transform, and load (ETL) tools for the input data, which is critical for the rapid deployment of AI technologies in an actual business. C7 indicates that the specific information required for the task should be explicitly defined and that its extraction should be possible. C8 indicates that all possible options for the output should be exhaustively prepared.

Using the derived conditions (C1–C9), we can assess the viability of the AI service system. To do so, we take the following two steps:

- Analyze the target business task and confirm whether C1, C2, . . ., and C9 are satisfied.
- For each unsatisfied condition, the consequences for the service users (practitioners) should be assessed.

When all conditions are satisfied or all possible effects of the unsatisfied conditions have been assessed, we conclude that the AI system can be implemented for the specified business task.

For analyzing the applicability of AI technologies, as mentioned in Section 2, three types for AI service systems are proposed in [6]. It is expected that we can use this method for assessing whether we can implement the selected type of AI service systems for a given business goal.

5 Analysis Examples

5.1 Case study for identifying business goals for AI service

Here, we try to confirm the effectiveness of the proposed method to identify business goals for AI service. For this purpose, we applied the proposed method to a specific business. We considered administration services in an insurance company and set the cost reduction as a top goal in this application. Using the goals-strategies decomposition, we can obtain the decomposition tree represented in Figure 6.

In the derived terminal strategies, S3-4, S3-5, and S3-6 are not related to the daily activities of the practitioners. Therefore, we assess whether S3-1, S3-2, and S3-3 satisfy the conditions derived through the proposed method. It was found that neither S3-2 nor S3-3 satisfies C1 because the activities in these strategies do not require any orientation or decision steps. This means that these strategies can be developed by an automation technology called robotic process automation (RPA) rather than AI technologies. By contrast, S3-1 satisfies all conditions (C1–C9) and we can obtain an “automatic assessment of insurance payments from medical reports” as a business goal and identify the activity where we assess the insurance payments from medical reports as a business task for an AI service system.

It is found that there are some candidates identified for achieving the top business goal through the goal tree and data scientists without the knowledge on the business domain

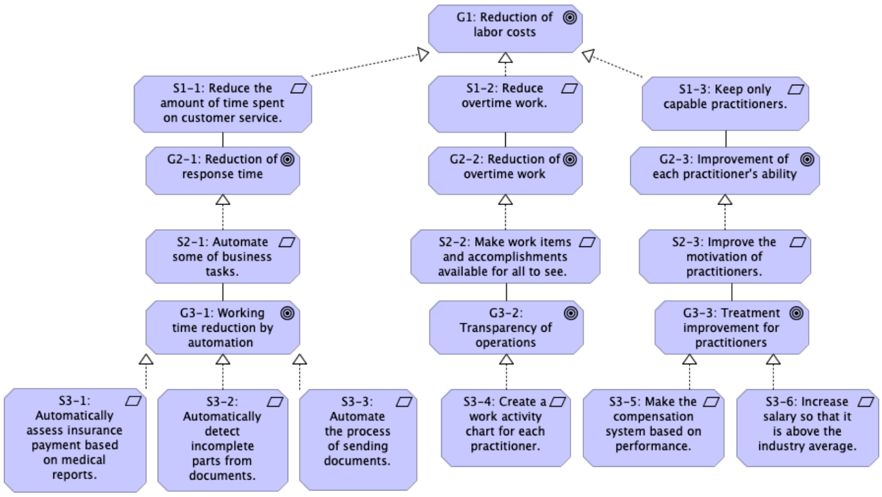

Figure 6: Result of goal-strategies decomposition

cannot derive them by themselves. Therefore as a typical use case of the proposed method, it is considered that practitioners in the business division derive the goal tree and identify the business goal for AI service system and data scientists confirm the results

5.2 Use case analysis for assessing the applicability of AI service systems

Herein, we attempt to confirm the effectiveness of the method for assessing the applicability of AI service systems explained in Section 4.3. As an experiment, we analyze some use cases and assess whether the identified conditions are essential for the applicability of the AI service system.

For this, we analyze six use cases of AI service systems in various industries and application domains [13]. Table 3 shows the business domains and business tasks for these use cases. AI service systems are developed and deployed in an actual business to execute these business tasks (T1, T2,. . ., and T6). We assessed whether the proposed conditions (C1, C2,. . ., and C9) for applicability were satisfied for each business task. Table 4 shows the results of the analysis.

Table 3: Use cases of AI service system

	Business Area	Business Task
T1	IT system management	Response to the text questions on the IT service.
T2	Parts management	Identify the target parts from an input image data and provide the part information.
T3	Office procedure management	Select a suitable business procedure for an external request and assign a practitioner.
T4	Insurance underwriting	Assess payment for insurance from the request document.
T5	Inquiry service	Assign the suitable practitioners for the inquiry.
T6	Customer support service	Issue the support ticket from the e-mail.

Table 4: Assessment Results

	C1	C2	C3	C4	C5	C6	C7	C8	C9
T1	○	○	○	×	○	n/a	○	○	○
T2	○	○	○	×	○	n/a	○	○	○
T3	○	○	○	○	○	○	○	○	○
T4	○	○	○	○	○	○	○	○	○
T5	○	○	○	○	○	○	○	○	○
T6	○	○	○	×	○	○	○	○	○

In T1 and T6, document categorization, and in T2, part identification from input data, are executed in the Resolution component. However, the features used in the document categorization process or during an image analysis cannot be explicitly qualified as intermediate outcomes. This means that AI engines whose roles are assessment and resolution are used in this service system. Therefore, we concluded that C4 is not satisfied in T1, T2, or T6. In addition, in T1 and T2, the input into the AI service system (Facts) is the inquiry text or product image, and these data are used directly as business objects (Perceptions) in the Orientation process. On these grounds, we decided that assessment C6 was not applied (e.g., n/a).

As results, it is found that most of the proposed conditions were satisfied in the use cases where AI service systems are running in actual businesses. Therefore we concluded that C1, C2,..., and C9 are necessary conditions for AI service systems to apply to enterprise business functions and this analysis can be conducted by practitioners without sufficient supports from data scientists.

6 Discussion

Through the analysis examples, we could confirm the operability of the proposed methods. Therefore, it is found that the proposed methods can be the solution for identifying the business tasks where AI technologies can be applied effectively without sufficient support from data scientists (RQ).

From the result of the case study in Section 5.1 , we found that the business task in which practitioners assess insurance payments from medical records can be supported or substituted using AI service systems. In fact, this business task is known as underwriting in the insurance industry, and AI service systems supporting underwriting have been introduced into a number of enterprises. It was reported that a huge number of labor costs have been saved by introducing AI service systems to this task [2]. We also found that business goals developed by AI service systems can be identified in real businesses by the proposed method without sufficient support of data scientists with deep knowledge of AI technologies. The proposed goal finding method does not consider any criteria that stop the goals-strategies decomposition, and the granularity of strategies at each level depends on the analyzers. From these perspectives, making the proposed method more detailed through application in various industries will be a focus of our future studies.

From the results of use case analysis in Section5.2, it is found that we can use the proposed method for assessing the applicability of AI service systems. However, the experiment showed that some exceptional cases arise when we use the proposed conditions to assess the viability of an AI service system. In some business functions, the task input (Facts) can be directly used in the orientation process, and in such instances, we do not have to consider C6 in the assessment. In a business task where the practitioners categorize documents or images for decision making, categorization engines based on machine learning are used. The engine implements categorization features that constitute its internal parameters. This means that the categorization engines contain both Assessment and Resolution components. In this case, although C4 is not satisfied, the AI service system completes the business task if C5 is satisfied. This is an exception, and an investigation into other exceptional cases is also an area of future research.

Though it is found that the practitioners can conduct the high-level design of AI service systems only by themselves using the proposed methods, data scientists should be involved in the detailed design stage and they require some domain knowledge used in the business analysis at the high-level design stage are required. Systematizing the type of knowledge

[2] https://artificial.io/company/blog/ai-for-commercial-underwriting-how-its-already-making-a-difference

required both practitioners in the business division and data scientists is also our future study.

7 Conclusion

In this study, we considered projects in which systems are developed using AI technologies. Many enterprises have started applying AI technologies for their business functions. When introducing AI technologies effectively, it is important to identify suitable business domains in the enterprise before planning a project. We proposed a GQM+Strategies-based method that divides the top business goal into strategies as part of a goals-strategies decomposition tree and identify the business goals and tasks for AI service systems. In addition, we proposed a method for assessing the applicability of an AI service system for the identified business tasks. Through an experimental application and a use case analysis, we confirmed the effectiveness of the proposed method. Improving the method to allow us to set the suitable metrics to assess the achievement of the business goal is one of the demonstrated business analysis applications of the proposed method.

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References

[1] A. Agrawal, J. Gans, and A. Goldfarb. *Prediction Machines: The Simple Economics of Artificial Intelligence*. Harvard Business Review Press, 2018.

[2] A. Aldea, M.-E. Iacob, J. van Hillegersberg, D. Quartel, L. Bodenstaff, and H. Franken. Modeling strategy with archimate. In *Proceedings of the 30th Annual ACM Symposium on Applied Computing*, pp. 1211 – 1218, 2015.

[3] S. Amershi, A. Begel, C. Bird, R. Deliner, H. Gall, E. Kamar, N. N. B. Nushi, and T. Zimmermann. Software engineering for machine learning: A case study. In *Proceedings of the 41st International Conference on Software Engineering*, pp. 291 – 300, 2019.

[4] K. Baclawski, E. S. Chan, D. Gawlick, Z. H. Liu, A. Ghoneimy, K. Gross, and X. Zhang. Framework for ontology-driven decision making. *Applied Ontology*, 12(3-4):245 – 273, 2017.

[5] V. Basili, A. Trendowicz, M. Kowalczyk, J. Heidrich, C. Seaman, J. Münch, and D. Rombach. *Aligning Organizations Through Measurement: The GQM+Strategies Approach*. Springer International Publishing, 2014.

[6] T. H. Davenport and R. Ronanki. Artificial intelligence for the real world: Don't start with moon shots. *Harvard Business Review*, 96(1):108 – 116, 2018.

[7] Y. Demchenko, C. de Last, and P. Membrey. Defining architecture components of the big data ecosystem. In *Proceedings of the International Conference on Collaboration Technologies and Systems (CTS)*, pp. 104–112, 2014.

[8] S. Earley. Analytics, machine learning, and the internet of things. *IEEE ITPro*, 17(1):10–13, 2015.

[9] D. Gawlick, E. S. Chan, A. Ghoneimy, and Z. H. Liu. Mastering situation awareness: The next big challenge? *SIGMOD Record*, 44(3):19 – 24, 2015.

[10] J. Heit, J. Liu, and M. Shah. An architecture for the deployment of statistical models for the big data era. In *Proceedings of IEEE International Conference on Big Data*, pp. 1377–1384, 2016.

[11] K. Hinkelmann, A. Gerber, D. Karagiannis, B. Thoenssen, A. van der Merwe, and R. Woitsch. A new paradigm for the continuous alignment of business and it: Combining enterprise architecture modelling and enterprise ontology. *Computers in Industry*, 79:77–86, 2016.

[12] M. Kim, T. Zimmermann, R. DeLine, and A. Begel. The emerging role of data scientists on software development teams. In *Proceedings of the 38th International Conference on Software Engineering*, pp. 96–107, 2016.

[13] A. Masood and A. Hashmi. *Cognitive Computing Recipes: Artificial Intelligence Solutions Using Microsoft Cognitive Services and TensorFlow*. Apress, 2019.

[14] Mitsubishi Chemical Holdings Corporation. Machine learning project canvas. https://www.mitsubishichem-hd.co.jp/news_release/pdf/190718.pdf.

[15] A. Osterwalder and Y. Pigneur. *Business Model Generation*. Wiley, 2010.

[16] J. Saat, U. Franke, R. Lagerström, and M. Ekstedt. Enterprise architecture meta models for it/business alignment situations. In *Proceedings of the 14th IEEE International Enterprise Distributed Object Computing Conference*, pp. 14–23, 2010.

[17] R. J. Sternberg. *Successful Intelligence: How Practical and Creative Intelligence Determines Success in Life*. Simon & Schuster, 1996.

[18] H. Takeuchi and S. Yamamoto. Business ai alignment modeling based on enterprise architecture. In *Proceedings of the 11th KES International Conference on Intelligent Decision Technologies*, pp. 155 – 165, 2019.

[19] The Open Group. *ArchiMate 3.1 – A Pocket Guide*. Van Haren Publishing, 2019.