A Proposal of Reference Model Driven Modeling Framework for Clarification of Business Concept

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ABSTRACT

In planning an IT system, conceptual models have been used widely to obtain an overview of the system of interest. The quality of concept models, however, depends on the skills and intuition of the people developing the models. As the result of the poor quality of conceptual models, stakeholders lack a common understanding of the concept causing inconsistencies in understanding system specifications. Therefore, in this study, we developed a method to create a conceptual model that can be designed by a person unfamiliar with the notion of conceptual models. We also report the application results of our method and future works.

Keywords: Conceptual Modeling, Reference Model, Ontology, Requirement Analysis

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1. INTRODUCTION

In IT system development, an important problem has been to reduce project failure rates for many years. The most frequently cited factor are problems in requirements analysis. In the research of IT system failure, the top three causes of project failure are all related to requirements analysis. A total of 46.9% of IT system failures is attributed to requirements analysis (The Standish Group, 1995).

According to the 2004 Industry Questionnaire about improving requirement analysis (Development Style, n.d.), there is a high demand for "needs to improve the quality by modeling." To support that, in the analysis of IT system development requirements, a conceptual model has been used to grasp the outline of the target system. Conceptual modeling is an activity that describes several aspects of the physical and social world around us for the purpose of understanding and communication, and a conceptual model is defined as the diagram created by that activity (Kayama et al., 2014). By creating a conceptual model, it is possible to share recognition among stakeholders, formalize tacit knowledge, and promote reuse and sharing of knowledge and standardization (Gemino & Wand, 2004). To obtain these advantages, the person who draws the model (hereinafter referred to as the modeler) needs modeling skills (literacy of modeling and reading and writing) (Kodama, 2001). Specifically, modeling knowledge and techniques that abstract things are required. However, regarding these modeling knowledge and techniques, there is no clear procedure or guidance that can be referred by

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experts, and Kodama contends that the modeler needs to acquire these skills by experience (Kodama, 2001).

Kodama also suggests following, "If you rely on the improvement of modeling skills based on experience, recognition problems occur when you discuss using a low-quality model written by a non-technical person with low modeling skills"(Kodama, 2001).

As a result of the poor quality of conceptual models, stakeholders lack a general understanding of concepts, which causes inconsistencies in understanding system specifications (Gemino & Wand, 2004). Therefore, the purpose of this study is to create a conceptual model by people unfamiliar with conceptual models and to reduce inconsistencies in understanding system specifications. Specifically, we propose a framework encompassing a procedure to create a model using a reference model. We will also propose the clarification of viewpoints. The evaluation method of this study is a seven-step evaluation using questionnaires and open coding of free text.

We describe the novelty of this study. In this study, we propose to make it easier for non-IT professionals to write models. A problem in previous studies (Yoshida, 2016) is that an axis for objective evaluation has not been established. And other studies (Yamagishi, 2016) show the procedure for creating a model for software development and the procedure for abstracting techniques (Yoshida, 2016), but not for describing business architecture. This proposal differs from previous studies in that it proposes to apply quality criteria focused on business architecture. Our study has four proposals of novelty as follows:

(1) providing a reference model;
(2) presentation of the specific creation procedure;
(3) application of the abstraction method to model creation; and
(4) proposal for quality criteria focused on business architecture.

This paper consists of five chapters. In Section 2, we describe previous studies of the conceptual model; Section 3 describes the procedure for creating a conceptual model; the evaluation is in Section 4; and Section 5 provides the conclusion.

2. PREVIOUS STUDIES

Based on previous studies, this section clarifies outlines the requirements for this study and the proposal, finally describe the novelty of this inquiry. Prior study is divided into the following: Study on the quality of models, Study on the quality of data, Study on syntax correctness, Study on modeling methods, and Study on ontology. We explain the novelty of this study in comparison to those studies.

2.1. STUDY ON THE QUALITY OF MODELS

In *A conceptual modeling quality framework* (Nelson *et al*., 2012), a combination of both LSS frameworks for evaluating the quality of models for which conceptual models have been created and a BWW framework for evaluating the process quality of modeling processes is suggested. Amongst these frameworks, the model quality evaluation type is proposed. Teeuw (Teeuw & den Berg, 1997) present six perspectives as a measure of quality. Based on these axes, the authors develop an evaluation framework for modeling a framework and tools consisting of four dimensions. The authors propose 1. Completeness; 2. Consistency; and 3. Clarity as the quality of user satisfaction. The authors also propose 4. Consistency; 5. Orthogonality and 6. Generality as the "internal" quality of the concept—i.e., the quality referring to the intrinsic properties of the concept. The authors explain the structure of the conceptual model in three dimensions: Specifications (entity, behavior, and item domain), Level of detail (composition, decomposition) and Abstraction level (abstract or concrete).

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Quality evaluation Study by Si-said (Si-said Cherfi *et al*., 2002) proposes a quality evaluation framework for conceptual models. We propose a quantitative quality evaluation method by measuring the three abilities. The three capabilities are Specification (Legibility, Expressiveness, Simplicity, Correctness), Usage (Completeness, Understandability), and Implementation (Implementability, Maintainability)

2.2. STUDY ON THE QUALITY OF DATA

International Standard SquaRE Series 1 (SquaRE) is one of the international quality criteria. It defines the diverse quality requirements of a wide range of stakeholders in systems and software (users, contractors, developers, etc.). It also presents a common set of thinking criteria for evaluating implementations (IPA, 2015). SquaRE defines the data quality model shown in ISO / IEC 25012. We focused on "lack of modeling skills" as one of the causes of recognition problems in requirement analysis and we investigated whether there was any prior study targeting this. Our study shows there is study on error judgment against the notation (Kayama et al., 2014). Lean modeling by Yamagishi is a modeling method that reduces UML notation to a minimum (Yamagishi, 2016). In this method, four levels of range, granularity, degree of detail, and degree of abstraction are proposed as levels for achieving the purpose of modeling. Scope is defined as narrowing the parts to be modeled in the business/system. Granularity is defined as the business hierarchy (financial level, management level, operation level) to be modeled. The detail level is defined as the degree of detail of branching of the business flow—for example, how far to express the exception processing. The abstraction level is defined as the abstraction level of the relationship between model objects. Also, UML notation is omitted for the notation used. The domain model proposed by Yoda is a model creation method for representing the concept of business (Yoda, 2015). In this creation method, ten categories for high-quality domain models are defined. Kono explains the importance of conceptual models to understand the tasks targeted for systematization (Kono, 2015). To that end, we propose a procedure for creating a conceptual model. The model-based thinking proposed by Yoshida proposes thinking techniques for using conceptual models without being limited to IT systems (Yoshida, 2016), of which good model conditions are presented. The condition is that the purpose and the point of view are fixed, the elements are covered, no extra elements are included, the abstraction level of the elements is appropriate and the relation of the elements is well expressed. Chaveesuk and Hongsuwan explain the importance of information quality in implementing Enterprise Resource Planning (ERP) systems; one of the quality models they propose is an information quality model (Chaveesuk & Hongsuwan, 2017).

2.3. STUDY ON ONTOLOGY

Various proposals have been made in methods for creating a conceptual model. One of them is to create a model based on natural language. Generally, the requirements are described in natural language, but a recognition problem arises because of the way understanding differs depending on a person's interpretation of natural language. Therefore, by writing the specification as a conceptual model, various attempts have been made to reduce recognition problems that tend to occur in natural language descriptions. Specifically, there is a billiard ball model (Langacker, 1999) developed from cognitive linguistics, and there is a study (Ida & Shigeo 2013) that applies this to the Japanese language. There are also many studies on conversion from natural language to specification description language (Omori & Araki, 2010), and there are studies on conversion to object orientation based on five English sentence patterns (Seko & Kaneda, 2012).

2.4. COMPARISON OF PRIOR STUDY AND PROPOSAL OF NOVELTY

This study differs from previous studies in the following four points.

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2.4.1. PROVIDING A REFERENCE MODEL

There are studies (Akayama *et al*., 2012) (Yamagishi 2016) (Yoda, 2015) (Kono, 2015) (Yoshida 2016) that show the procedure for creating a model for non-technical engineers, but these are for studies in software modeling in system development. This proposal targets a conceptual model of work in requirements analysis. In this proposal, we propose a creation procedure using a reference model.

2.4.2. PRESENTATION OF SPECIFIC CREATION PROCEDURE

Regarding the presentation of specific creation procedures, there are studies on the easy-to-use model creation procedures (Yamagishi 2016) (Yoshida 2016). There are also studies to convert natural language into a model (Langacker, 1999) (Ida & Shigeo 2013) (Omori & Araki, 2010). In this proposal, the preparation procedure is summarized focusing on the purpose of the business architecture.

2.4.3. APPLICATION OF ABSTRACTION METHOD TO MODEL CREATION

The application of abstraction techniques to model creation has been proposed in previous study (Yamagishi 2016) (Yoshida 2016). In this proposal, we applied the abstraction method to the creation of a conceptual model for the purpose of business understanding.

2.4.4. PROPOSAL FOR QUALITY CRITERIA FOCUSED ON BUSINESS ARCHITECTURE

The existing quality standard study (Nelson *et al*., 2012) (Teeuw & den Berg, 1997) (Si-said Cherfi *et al*., 2002) (Chaveesuk & Hongsuwan, 2017) covers conceptual model whereas the International Standard SquaRE Series (IPA, 2015) covers data quality. The quality of the conceptual model has been proposed in existing studies (Yamagishi 2016) (Yoshida 2016) (Kayama et al., 2014). Specifically, Yoshida's proposal (Yoshida 2016) explains the elements of a good model; however, is a problem that an axis for objective evaluation has not been established. Therefore, this proposal creates a quality criteria focused on the business architecture.

2.4.5. SUMMARIZES THE RESULTS OF THE PREVIOUS STUDIES

Table 1 summarizes the results of the previous studies listed in the aforementioned section. We classify prior study as follows: specific quality criteria; easy-to-use syntax / notation; easy-to-use model creation procedure; conversion of natural language to specification language; abstraction method; and conceptual modeling. Conversely, we propose: providing reference model, presentation of concrete preparation procedure, application of abstraction method to model preparation, and proposition of quality criteria focused on business architecture. The basis of the novelty is explained below.

Table 1 Comparison of scope of previous studies and this proposal

	Nelson,Teew Si-said SQuaRe(IPA) Kayama Chaveesuk	**Yamagishi Yoda,Kono Yoshida Akayama**	**Langacker**	**Ida,Oomori Seko**	**Our Proposal**
Specific quality criteria	✔	✔			✔
Easy-to-use syntax / notation		✔		✔	✔
Easy-to-use model creation procedure (for non-technical)		✔			✔

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Conversion of natural language to specification language			✔	✔	✔
Abstraction method		✔	✔		✔
Conceptual modeling		✔			✔
Providing reference model					✔
Presentation of concrete preparation procedure					✔
Application of abstraction method to model preparation					✔
Proposition of quality criteria focused on business architecture					✔

3. SUGGESTIONS

This chapter provides an overview of the proposal.

3.1. THE CRITERIA OF GOOD MODEL

In designing this proposal, we define the criteria of good model and bad model. We referred to the previous study described in the previous chapter for our definitions. As a result of the definition work, the criteria were divided into the appearance and content of the model. In this proposal, we create processes and tools to meet these criteria and build a framework combining them.

3.1.1. DESCRIPTION OF CRITERIA FOR QUALITY

We describe the definition of good model quality criteria in this section. This section describes purpose suitability, consistency of viewpoint, consistency of abstraction level, completeness, consistency between models, vocabulary consistency, understandability, semantic accuracy, and structural accuracy.

3.1.1.1. PURPOSE SUITABILITY

Purpose suitability means there is no conflict between the purpose defined when writing the model and the content described. We provide specific examples that have a low degree of purpose suitability. Despite the purpose of writing a model that represents the difference between make-to-order (start production after ordering) and prospective production (start production before ordering), the model does not show the context of order and production.

3.1.1.2. CONSISTENCY OF VIEWPOINT

Consistency of viewpoint means that multiple viewpoints are not mixed in the model. Specifically, this is the case where the agents and functions of the manufacturing department of the customer are described although it should be written from the viewpoint of the customer. It is because such agents and functions would normally not be noticed from the viewpoint of the orderer.

3.1.1.3. CONSISTENCY OF ABSTRACTION LEVEL

Consistency of abstraction level means there is no variation in the abstraction level of the vocabulary, and the relation between the vocabulary and the vocabulary in the model. Specifically, while there is the phrase "person in charge", when the person in charge of another

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organization appears under their real name, consistency of the abstraction level is not maintained.

3.1.1.4. **COMPLETENESS**

In SquaRE, it is defined as "the degree to which target data related to an entity has values for all expected attributes and related entity instances in a specific usage situation." (IPA, 2015). For example, for employee databases, completeness is considered to be low if some employee records do not contain data on phone numbers that can be contacted by the employee in the event of an emergency. This SquaRE definition cannot be applied as it is to the completeness of the model because it applies to the completeness of the data content. Therefore, in this proposal, we define completeness as all information necessary to achieve the purpose is captured and there are no insufficiencies. Completeness is low if the product does not exist in the model despite the model describing the sales structure of the product.

3.1.1.5. **CONSISTENCY BETWEEN MODELS**

Consistency between models in this proposal means there are no contradictory elements between models. The description of the functions and roles listed in the use case diagram may not be represented in the conceptual model diagram. SquaRE (IPA, 2015) defines consistency as follows: Consistency is the degree to which data has attributes that are free from contradiction and are coherent with other data in a specific context of use. It can be either or both among data regarding one entity and across similar data for comparable entities. An example of less consistency is the use of synonyms. The dictionary term used to define the data may be useful to avoid such cases. We call this vocabulary consistency. The definition of consistency also refers to whether there is a logical contradiction between data. For example, an employee's date of birth cannot be later than the date of adoption. This represents a constraint on the attributes of the data. Therefore, it is not appropriate as a quality condition of the model. Thus, we define this logical contradiction as no absence of logical contradiction between models, as a part of the criteria for quality (consistency between models).

3.1.1.6. **VOCABULARY CONSISTENCY**

SquaRE (IPA, 2015) defines two consistency definitions. Definition (1) “refers to whether a synonym is not included,”—for example, prohibit to use contract and agreement in the same sentence. Definition (2), “there is no logical contradiction among data,”—for example, that an employee's date of birth cannot be later than the hire date. When considering the quality of the model, definition (1) was defined as vocabulary consistency; while definition (2) represents constraints on data attributes and is not appropriate as a quality condition for the model. Therefore, in this proposal, we define Definition (2) as consistency.

3.1.1.7. **UNDERSTANDABILITY**

We define understandability as being where the content of the created model is actually understood by the other party.

3.1.1.8. **SEMANTIC ACCURACY**

Semantic accuracy indicates the degree to which the created model matches the actual situation. For example, "when the section manager has the approval authority in the model even though the section manager does not have the approval authority," there is no semantic accuracy.

3.1.1.9. **STRUCTURAL ACCURACY**

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

Structural accuracy is the quality condition of appearance, not the content of the model. We evaluate whether or not this is consistent with the notations of the model we propose. In regards notations, the problem is that objects are assigned as objects or agents (persons, roles), and relationship lines are not assigned actions. For example, the act of ordering goods is not expressed using a relational line between the 'object' (goods) and 'to order;' rather "order goods" is often notated above the relationship line.

3.1.2. SUMMARY OF EVALUATION CRITERIA

Table 2 shows a summary of the evaluation criteria.

Table 2 Summary of evaluation criteria

Conditions		**Criteria for quality**
For Contents	There is no conflict between the purpose defined when writing the model and the content described	Purpose suitability
	There is no mixed multiple viewpoints in the model	Consistency of viewpoint
	There is no variation in the abstraction level of the vocabulary and the relation between the vocabulary and the vocabulary in the model	Consistency of abstraction level
	All information necessary to achieve the purpose is covered and there is no shortage	Completeness
	there is no contradictory element between models	Consistency between models
	No synonyms	Vocabulary Consistency
	model is actually understood by the other party	Understanding
	model matches the actual situation	Semantic accuracy
For Structures	it follows the notation of the model we propose	Structural accuracy

3.1.3. SUMMARY OF THE RELATIONSHIP BETWEEN PRIOR STUDY AND QUALITY CRITERIA

Table 3 summarizes the relationship between prior studies (Nelson *et al*., 2012) (Teeuw & den Berg, 1997) (Si-said Cherfi *et al*., 2002) (IPA, 2015) (Yamagishi, 2016) (Yoda, 2015) (Kono, 2015) (Yoshida, 2016) and the quality criteria of the good model.

Table 3 Summary of the relationship between prior studies and quality criteria

	Nelson	**Teeuw**	**Si-said**	**SQuaRE**	**Yamagishi**	**Yoda**	**Kono**	**Yoshida**
Purpose suitability								✔
Consistency of viewpoint		✔			✔	✔	✔	✔
Consistency of abstraction level		✔			✔	✔	✔	✔

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

Completeness		✔	✔	✔				
Consistency between models				✔				
Vocabulary Consistency		✔		✔				
Understanding			✔	✔				
Semantic accuracy		✔	✔	✔	✔	✔	✔	✔
Structural accuracy	✔				✔		✔	

3.2. DEFINITION OF BUSINESS CONCEPT MODEL IN THIS PROPOSAL

In this proposal, the business conceptual model is defined as the model for describing the architecture related to the business.

3.2.1. THE EFFECT OF SIMPLIFYING THE NOTATION

This notation assumes UML-class diagrams but omits multiplicity and attributes.

This is to simplify the description as much as possible. Identifying the attributes and multiplicity of an object in constructing a system is a necessary task required to define the object; this, however, requires time for analysis and evaluation. In regards the applied scenario of the method proposed, we estimate the architecture of work in meetings and material preparation, and consider is necessary to be able to think as simply as possible. When including the notation of multiplicity and attributes, there is an inherent problem in that it takes too much time to do in meetings and material preparation. Therefore, in this notation, simplicity is given priority by simplification.

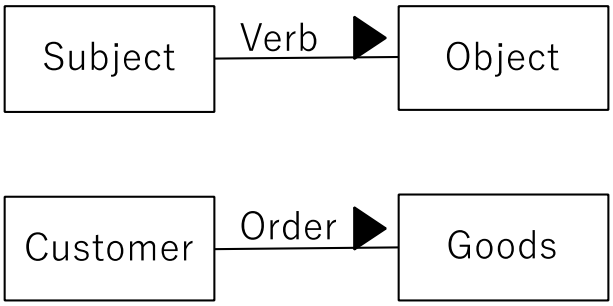

Figure 1 A sample of the business task model notation

3.3. DESCRIPTION OF THE CREATION PROCESS

This chapter describes the specific description process using the method. To make the explanation easy to understand, we use the creation of a conceptual model for a task as an example.

3.3.1. CLARIFICATION OF VIEWPOINTS (SELECTION OF BUSINESS HIERARCHY)

In this chapter, we describe the business hierarchy. The purpose of this sub-process is to define the level of abstraction of information by selecting the hierarchical level of work. The purpose of this process is to clarify from which point of view the model is to be written. For that purpose, defines three properties of “business hierarchy”, “business roles”, and “concern”. The modeler selects a business hierarchy using a reference model for definition.

We describe the business hierarchy used as a reference model. In this work hierarchy model, we divide work levels into six levels from 0 to 5 and define the levels—namely, Level 0; value

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chain (business strategy level); Level 1: strategic (business strategy level); Level 2: tactical (business tactical level); Level 3: operational (level for considering and designing business processes as operations); Level 4: activities (a level at which individual operations of business processes are individualized); and Level 5; action (a minimum unit level at which individual business operations are actually executed). This is then further divided into three major classifications using a hierarchy based on differences in interest. We classify financial level to include Level 0 and Level 1; management level to include Level 2, Level 3 and Level 4; and operational level to include Level 5. Further specific cases are described together.

The hierarchy of business divisions of operating companies is shown as a 'hierarchy due to differences in an organization,' as an example. By using this reference model, the modeler selects the most suitable job hierarchy level in respect of the purpose to create. If the reference model does not fit the task, it is possible to refer to the reference model and describe the task hierarchy independently. In creating this reference model, we refer to studies described by BPTrends (Brown, 2016) and GUTSY 4 (Watanabe, 2010). The hierarchy created in this example is "Activities". Table 4 shows an example of the job hierarchy.

Table 4 the reference model of the job hierarchy

Level	**major class**
Level 0 value chain (business strategy level)	Financial level
Level 1 Strategic (business strategy level)	
Level 2 tactic (business tactic level)	Management level
Level 3 Operational (level for considering and designing business processes as operations)	
Level 4 Activities (a level at which individual operations of business processes are individualized)	
Level 5 Action (a minimum unit level at which individual business operations are actually executed).	operation level

3.3.2. THE CLARIFICATION OF VIEWPOINTS (SELECTION OF BUSINESS ROLE)

The purpose of this sub-process is to define the point of view when designing a business concept model by selecting the role of the business. In this sub-process, the modeler uses the reference model to select business roles. The business role reference model is divided into viewpoint classifications: viewpoint of use, viewpoint of operation and viewpoint of development/support. The operational viewpoint is further divided into three parts: the person in charge's viewpoint, the manager's viewpoint, and the management perspective. An example is described for each of these categories for ease of understanding. By describing the viewpoint of "who is doing what," the viewpoint of not only the role but also the lifecycle can be included. Specifically, for "viewpoint of use", "customer who uses service" is provided as an example. As a point of view, "point of view when the customer uses the service" is mentioned. The "operator's viewpoint" gives "an operator who provides service to a customer" as an example. In addition, "the point of view when the person in charge provides the service" is mentioned as the point of view. For the "manager's point of view," "manager, department head" is mentioned as an example. Also, as a point of view, "point of view when managing the service of the manager" is mentioned. An example of a "management perspective" is "management class".

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Also, as a point of view, "the point of view when the manager manages the service financially" is mentioned. As in the “Development and Support Perspective,” modelers are allowed to state their own business roles. Table 5 shows the reference model. The task role selected in the sample is "operator's viewpoint".

Table 5 Business Role Reference Model

Viewpoint of ~		**Example**
Utilize		Customer
Operate	Operator	Operator
	Administrator	group leader
	Manager (Executive)	President, officer
Develop / support		System developer, maintenance

3.3.3. CLARIFICATION OF VIEWPOINT (CONFIRMATION OF CONCERN)

The purpose of this sub-process is to make the purpose more specific by describing things to focus on for the task being explained. The output is free text to describe the concern. A description example is provided as a reference model. The example of a car sale is provided as a specific example. "When selling a new car, the customer selects a model, but for a used car, I would like to express the difference in selecting a car from in-store stock."

"When selling a new car, the customer selects a model, but for a used car, I would like to express the difference in selecting a car from in-store stock."

Figure 2 Reference model describing the concern

The task role selected in the sample is the operator's viewpoint. Figure 3 shows an example. The free text for the relevant vehicle in the example described is as follows, "I want to make a diagram showing the relationship between the master, the order, and the person in charge."

"I want to make a diagram showing the relationship between the master, the order, and the person in charge."

Figure 3 The free text for the relevant vehicle in the example

3.3.4. CLARIFICATION OF STRUCTURE

The purpose of this process is to clarify the scope, functions, and scope of responsibility for the functions. To achieve this, the modeler creates a context diagram and use case diagram. A description example is prepared as a reference model. The rules for creating context diagrams and use case diagrams follow the notation of UML (OMG, 2015).

This chapter describes creating context diagrams. The purpose of creating a context diagram is to clarify the scope of the task or business. When designing a context diagram, the role selected in clarifying the viewpoint needs to be represented as an agent. An example is presented as a reference model. The example of a ‘master arrangement in order system development’ is provided as a reference model. Figure 4 shows an example context diagram.

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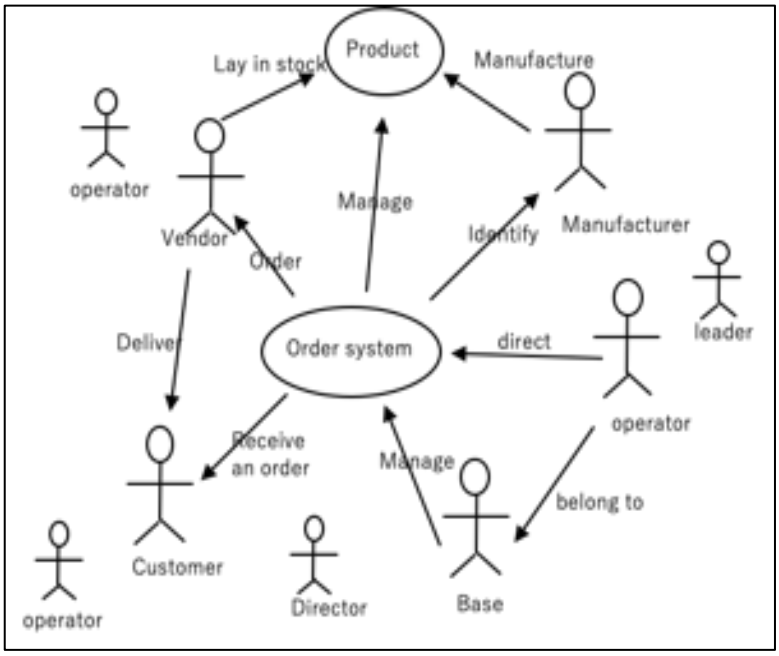

Figure 4 Context diagram sample

3.3.5. CLARIFICATION OF STRUCTURE (CREATION OF USE CASE DIAGRAM)

This chapter describes the creation of use case diagrams. The purpose of creating a use case diagram is to clarify the target function and to clarify the relationship between the function and the area of responsibility. As with context diagrams, use case diagrams also require agents to obtain their viewpoints. The example of a 'master arrangement in order system development' is provided as a reference model. Figure 5 shows an example of a use case diagram.

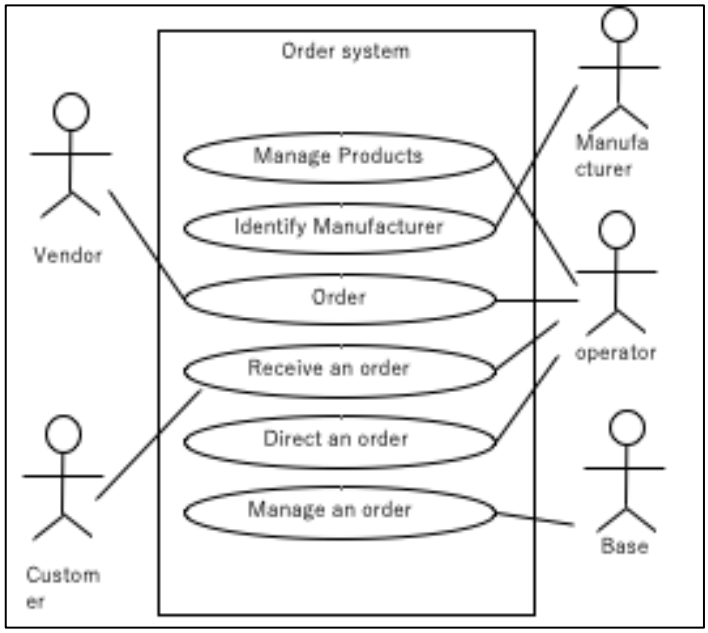

Figure 5 Reference models and examples

3.3.6. CLARIFICATION OF CONCEPTUAL RELATIONSHIPS

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The purpose of this process is to create a business concept model, which is the final product of this proposal. To achieve this, we perform lexical connection and structuring. Connection patterns of vocabulary are prepared as reference models.

Firstly in the connection of vocabulary, a vocabulary collection (vocabulary group) connecting the vocabulary and the vocabulary using a relationship line is created. A vocabulary group using a reference model is also created. Consequently, the vocabulary groups are further connected by structuring to make a business concept model.

3.3.7. VOCABULARY CONNECTION

The purpose of this process is to connect the vocabulary and the vocabulary and create a vocabulary group that is a part of the business concept model. Refer to the reference model that describes the connection pattern of vocabulary when creating the vocabulary group. The connection pattern is composed of the following five patterns. Figure 5 shows a reference model of connection patterns of vocabulary. Modelers can write the notation and structure of their own models with reference to similar patterns. The five patterns are described below. Relationship between subject, verb, and object refers to a concept represented by the relationship between a subject and a predicate. For example, the customer orders from the store. At the time of creation, connect the relationship line from subject to object according to the relationship between subject, verb, and object while looking at the use case. Next, set the verb on the relationship line. The following is an example of the relationship between subject, verb, and object.

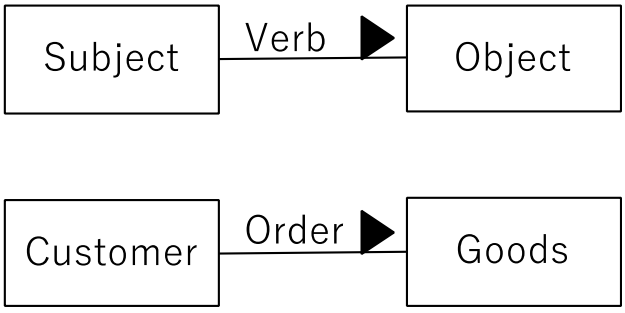

Figure 6 Relationship between subject, verb, and object

The relationship of "A is B" is a relationship represented by the first sentence pattern of English. Represents the relationship between generalization and inheritance in the context of UML. Specifically, hotels are accommodations, light cars are cars, etc.

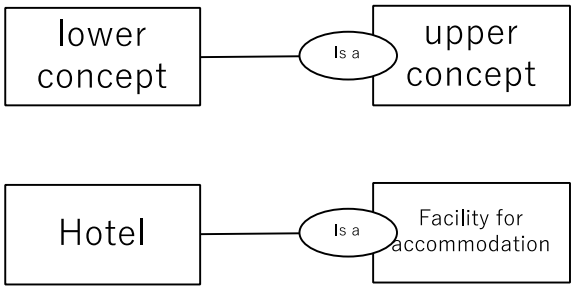

Figure 7 Relationship of "A is B"

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The relationship of "A is a part of B" represents the relationship between whole and part. Represents an aggregation relationship in UML. Specifically, it is an example that the tire is a part of a car.

The relationship of "A has a B" represents an ownership relationship. Specifically, an order has a product.

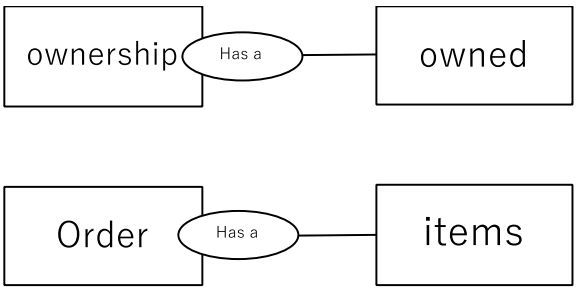

Figure 8 Relationship of "A has a B"

The relationship of "A is an attribute of B" represents the relationship between an object and an attribute. Specifically, the order date is the attribute of the order.

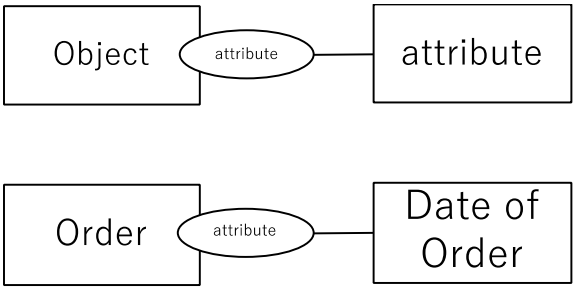

Figure 9 Relationship of "A is an attribute of B"

3.3.8. STRUCTURALIZATION

The purpose of this sub-process is the completion of the business concept model. The modeler connects the groups of vocabulary created for that purpose. Figure 10 shows a sample of the completed business concept model.

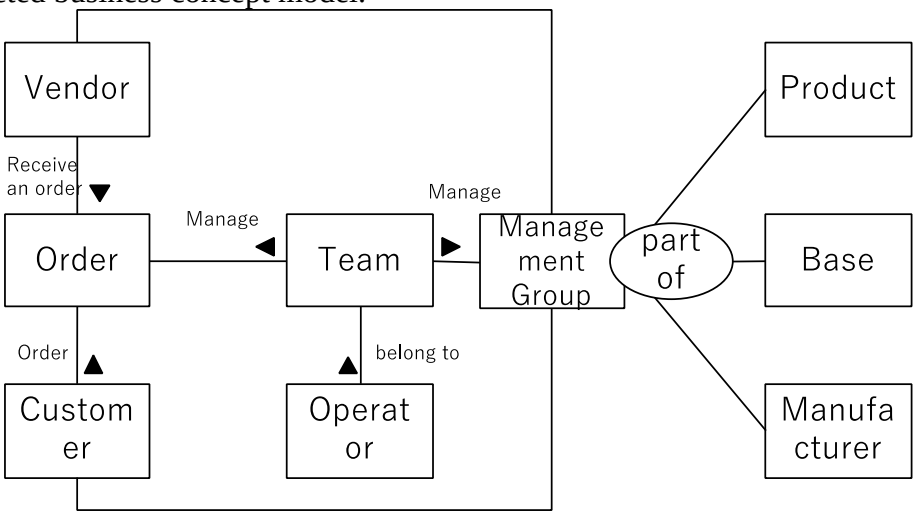

Figure 10 A sample of the completed business concept model

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

3.3.9. EVALUATION OF CREATED BUSINESS CONCEPT MODEL

The purpose of this process is to confirm that the created business concept model meets the conditions of a good model. Check items are prepared as reference models. Table 6 shows the check items.

Table 6 Check items

Category	**conditions**
Notation	Syntactic accuracy
Content	Semantic accuracy
	Consistency between models
	Vocabulary Consistency
	Purpose suitability

4. EVALUATION

To evaluate the proposed method, a task concept model is created using this framework. We then conduct a survey.

4.1. EVALUATION PLAN

This evaluation aims to confirm that the subject can express they want to explain in the diagram based on the proposed method. The evaluation points are understandability, availability, and effectiveness. understandability, availability, and effectiveness are evaluated using analysis of a seven-step order scale and analyzing the free text in the survey. We asked the evaluation collaborators to create a business concept model using the framework and respond to a survey.

4.1.1. MODEL CREATION PROCEDURE BY EVALUATION COLLABORATOR.

The overall flow of the evaluation work is as follows.

(1) Description of proposal contents
The proposer explains the contents of this proposal and the evaluation procedure to the evaluation collaborator.
(2) Creation of business concept model
The evaluation collaborator creates a business concept model according to the evaluation procedure instructed by the proposer.
(3) Create a questionnaire
After completion of the work, evaluation collaborators complete the questionnaire.

4.2. QUESTIONNAIRE DESIGN

After the model is created using the framework, survey participants will be given a questionnaire consisting of nine questions. There are three questions that examine the three subjects of study: understandability, usability and effectiveness. For each answer option, a seven-step ordinal scale of disagree (-3 to -1), neither agree nor disagree (0) and agree (+1 to +3) is used. The answer agree (+1 to +3) is regarded as a positive evaluation (effective). Further, we will prepare an input field where evaluation collaborators can comment freely. We asked collaborators to respond to the following questions; "Which part was easier to work?" and

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

"Which part was more difficult?" regarding understandability and usability; and "Which part was more useful?" and "What other business can we apply?" Collaborators were also asked to respond to the following; "Please provide feedback if you are concerned about the entire process."

4.3. EVALUATION RESULTS

4.3.1. THE ATTRIBUTE OF EVALUATION COLLABORATOR

The evaluation collaborators are six Japanese, all of whom studied systems engineering at the graduate school level. The number of years of work experience is distributed from those without experience to those with more than 20 years as a graduate. There are four people with or without experience in software development, and one for each of the five to ten years' and eleven to twenty years' experience respectively. Regarding the position in business, there are two process managers, three people in charge of work, and one student. A process manager is a department manager or manager who directly manages work vehicles. The work manager is the person in charge of direct work.

We created a description procedure and confirmed whether the subject could create a conceptual model according to that procedure. As a result, it was confirmed that a model could be created.

4.4. RESULT OF QUESTIONNAIRE

The result for questionnaire were as follow. Table 7 shows the answer for questionnaire.

Table 7 The answer for questionnaire

	+3	**+2**	**+1**	**0**	**-1**	**-2**	**-3**	**N/A**
usability	1	2	2	0	1	0	0	0
availability	1	1	1	1	1	0	0	1
effectiveness	2	3	0	1	0	0	0	0

The answer for understandability was one for "+3", two for "+2", two for "+1", and one for "-1". As for usability, opinion was divided that there was one evaluation each from "-1" to "+3" and one for "no answer". As for effectiveness, two for "+3", three for "+2", one for "0".

We implemented the open coding procedures proposed by Kobayashi et al. (2018), as follows:

Step 1. From the free description field of the questionnaire and the verbatim recorded interview data, identify the relationship using the stakeholder map and decide on the viewpoint to be used in the categorization of the affinity diagram used in the next procedure. Here, to ensure that the proposed method is satisfactorily understandability, availability, and effectiveness, we consider the perspective based on the item "what can be obtained by using the proposed method for describing."

Step 2. We categorized the comments in the free description using an affinity diagram, with the aforementioned viewpoint as an axis, for each content having similar meaning.

Step 3. Name the category (a generic term called open coding result).

In addition, following Nahid (2003), we implemented the right evaluation method by confirming it with a researcher (second author) who is familiar with qualitative research methods.

As a result of open coding, we extracted positive comments. Comment on "understandability", we extracted "(1) Instructions are specific" and "(2) Procedure is clarified". Comment on "availability", we extracted "(3) Easy to find omissions and contradictions". Comment on "effectiveness", we extracted "(4) By aligning the level of abstraction, confusion can be avoided.".

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

On the other hand, we extracted negative comments as follows. From the comment of "understandability", we extracted “where the concept hierarchy is created”, “the type of ontology is difficult to understand”, and “it is difficult to determine an abstract expression”. From the comment of "availability", we extracted the comment “Too Many steps”.

4.5. Consideration

The evaluation results show that the proposal suggests the effectiveness in deepening and sharing the understanding of the system. The positive comments of questionnaire responses suggest the result was effective. Based on the comments for "understandability", We evaluated that both of comment (1) and comment (2) suggested the effects of the reference model, the preparation procedure, and the evaluation criteria. Based on the comments for "availability", We evaluated that comments (3) suggested the effects of the preparation procedure. Based on the comments for "effectiveness", We evaluated that comments (4) suggested the effect of adjusting the level of abstraction.

On the other hand, the questionnaire results point out the limitation of this study. The limitation of this study is shown below. There is a problem with the function of aligning the abstraction level from the three points described in the questionnaire results: it is difficult to create a concept hierarchy, it is difficult to understand the type of ontology, and it is difficult to determine abstract expression. These three points are all point to the process of determination of the abstraction level, and it was considered that it is difficult to understand the task of aligning the vocabulary abstraction level, or difficult to use because the instruction was unclear.

From the points described in the questionnaire results, it is suggested there is a problem in the instruction about the procedure of work and the specific writing method. "Where to use the English 5 grammar" and "How to write a conceptual diagram". From the point out that there are many procedures described in the questionnaire, it is inferred that it feels too much preparatory work for making only one figure. We consider there are two possible reasons for that. One is the possibility that the evaluation collaborators do not feel the necessity of taking steps due to their high modeling skills. The other is the possibility that the "ease of use" presented simply as a proposal and the number of procedures contradicts each other. The former is considered as a natural outcome, but when it is attributed to the latter, it can be judged that there is a problem from the viewpoint of usability. The point of "there are people and things mixed in the figure" described in the questionnaire was judged to point to the problem concerning the notation of the proposed business concept model. In this notation, objects and people are described with the same symbol, so it is judged that the abstraction level is high, and that point is an obstacle to understandability.

5. CONCLUSION

The purpose of this study was to create a conceptual model by people unfamiliar with conceptual models and to reduce inconsistencies in understanding system specifications. We proposed a method to create a conceptual model that can be drawn by people unfamiliar with the conceptual model. The evaluation method of this study was conducted by seven-step evaluation by questionnaire and open coding of free description column. We got the result that it was effective effectively by the questionnaire. Finally, we describe the issue. This framework has the issue that it is difficult to draw a diagram because the function to adjust the abstraction level is lacking and the usability is low because the number of steps is large.

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

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