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A Comparative Analysis of Business Model Notations

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Abstract

Although there were many comparative literatures of Business Models, there were not clear comparison criteria. Therefore, these comparisons were fragmented based on different viewpoints. In general, questions on business models can be categorized by interrogatives. In other words, the interrogatives imply a set of key features of business model notations. The feature category of business models using the interrogative will provide a unified way to compare different business models.

The paper first defines the fifteen key features of Business Model Notations with five interrogatives. Then we concretely compare typical Business Model Notations based on the key features. The result clarifies the difference of Business Model Notations by using the proposed comparison framework. The result also implies a method to choose appropriate business model notations by using a set of interrogatives which correspond to important questions on business models.

Keywords

Business Model Notation, Business Process Model, Business Goal Model, Business Value Model, Enterprise Architecture, comparison framework, interrogative

1. Introduction

As spreading the concept of Business Modeling, many Business Modeling Notations are proposed to describe Business Models. At the same time comparative studies of Business Models also are increasing. However, there was a problem that previous comparative studies on the Business Modeling approaches use various different criteria. The cause of the problem is there is no unified concrete comparison framework.

Matters of stakeholders who are interested in the business model may be variable. Some stakeholders may want to ask the “How” questions. Other stakeholders may not want to ask “How” questions, but may want to ask “Why” questions. It is useful if we provide a method to choose Business Model Notations based on the set of interrogatives what are important for the stakeholder. In general, questions on business models can be categorized by interrogatives. In other words, the interrogatives implies a set of key features of business model notations. The feature category of business models using the interrogative will provide a unified way to compare different business models.

This paper proposes a clear evaluation framework to compare Business Model Notations by using interrogatives. Then ten Business Model Notations are compared by using the proposed comparison framework.

The notations of business modeling have continuously evolved. This section reviews previous researches on business model notations.

1.1 Business Process Modeling

Aldin and de Cesare (2016) surveyed four business process modeling notations: (1) Data Flow Diagram (DFD), (2) Business Process Modelling Notation (BPMN), (3) Activity Diagram, and (4) Integration Definition for Function Modelling (IDEF0). They concluded that no modeling technique is better than another. Schoknecht et al. (2017) analyzed the similarity of business process models. They defined business models as the sequences consist of activities, events, and connectors. BPMN is standardized by OMG (2011).

The business process modeling approaches are also studied by Braun et al. (2015), and Brown, Kelly and Querusio (2011). Baslyman et al. (2017) proposed an Activity-based Process Integration approach that incrementally integrates activities of a new process to current processes. They use *i** framework and URN (User Requirements Notation) to describe goal models and business process integration for the emergency process in the hospital.

The DEMO process model has been proposed by Dietz (2006). DEMO stands for Design and Engineering Methodology for Organizations.

Rima, Vasilecas and Smaizya (2011) compared business rules and business process modeling languages. Schoknecht, Thaler, and Fettke (2017) analyzes the similarity of business process models from the theoretical viewpoints.

1.2 Business Value Modeling

Osterwalder and Pigneur (2010) proposed the Business Model Canvas (BMC). The BMC had been used to describe e-Health business models. Chen and Mehta (2013) compared Telemedicine business models using nine key elements of BMC.

Gailly and others (2016) described Core Value Ontology. The focus of the e3-value fragment is on the exchange of the maternity care services (i.e., a value object) between the hospital (i.e., an actor) and the high-risk pregnant client (i.e., a market segment). As a compensation for these services, the client will pay money to the hospital. Furthermore, the responsibility of the hospital for executing the activity of monitoring the high-risk patients is also incorporated. This activity is the end of a scenario path, which starts with the need of the future mother to obtain maternity care (see dotted lines). Although the e3-value approach describes functional goals as the end of scenario paths, non-functional goals are not considered in the approach. Gordijn and Akkermans (2003, 2011) proposed the e3-value ontology. Dantanarayana and others (2014) describes the value object category for the surgery case using the e3-value model. Kinderen and others (2014) proposed a mapping between e3-value model and ArchiMate using the DEMO process model, which has been proposed by Dietz (2006). ArchiMate is the standardized language to model Enterprise Architecture based on TOGAF. TOGAF is the most popular EA framework. As ArchiMate has rich features to represent EA, there are many researches to design business models and business values. Singh and others (2014) also proposed a value creation modeling approach by integrating the e3-value model and ArchiMate.

The CVCA (Customer Value Chain Analysis) was proposed by Ishii (2010) and Donaldson, Ishii and Sheppard (2006) to analyze the customer value chain. Although CVCA describes actors and value exchange flows among actors, it can't represent the goals of actors.

1.3 Business Goal Modeling

Yu et al. (2011) introduced the i* (i star) framework to describe an organization as being composed of social actors, soft goals, tasks, and resources. The i* framework had originally proposed by Yu (1997). Soft goals are realized by mutually-dependent social actors who perform tasks with the provided resources. System requirements are defined based on the concept of actors (stakeholders), goals, tasks,

soft goals (non-functional requirements), and resources. In setting goals, judging criteria and conditions are clarified, and procedures for achieving goals are defined based on tasks. The i* framework consists of two models—Strategic Dependency (SD) and Strategic Rationale (SR). The SD model is used to analyze interdependencies between actors; the SR model, those within actors. Using these two models, the current operation (as-is) and the operation after system implementation (to-be) are compared and analyzed, and the results can be applied in transforming the business process.

ARM (Actor Relationship Matrix) had been proposed by Yamamoto et al. (2009) to resolve problems to create *i** goal models. The business modeling approach using ARM has been discussed in Yamamoto (2016a). Yamamoto and et al. (2019) proposed the e-Health business model review method using ARM by analyzing interrelationships among stakeholders.

Yamamoto et al. (2018c) proposed a business modeling method for e-Healthcare based on ASOMG analysis. ASOMG stands for Actor, Service, Object, Means and Goal. Although the approach identifies services, objects, means and goals for actors, the interdependency among actors has not been considered.

Niven (2006) showed that the Balanced Scorecard (BSC), proposed by Kaplan and Norton (1992), can be used to analyze corporate management strategies using a strategy map and performance evaluation indicators. The strategy map of this approach is a framework based on goal decomposition for developing, implementing, and evaluating strategies in a multidimensional manner from the four perspectives of *financial*, *customer*, *business processes*, and *learning and growth* (innovation). BSC places strategic goals seen from the financial perspective at the top, and the strategy map is then used to decompose these goals hierarchically into sub-goals—for example, those for achieving the top goal from the customer perspective, those representing business process goals for achieving the customer perspective goals, and those for learning and growth in order to achieve the business process goals. Furthermore, the method defines Critical Success Factors (CSFs) as indicators for evaluating the results of activities for achieving these goals, in addition to Key Performance Indicators (KPI) for evaluating said factors in a quantitative fashion. The KPIs are set in order to monitor the status of the final goal achievement.

GQM provides *questions* related to data items for evaluating *goal* adequacy, and it evaluates whether the goals are achieved by using the answers to those questions as measurement *criteria*, or metrics. Basili et al. (2010) proposed the GQM+ Strategy Approach as a method for linking business strategies and software development using GQM. This approach links business, software, and projects, and it defines goals using GQM. What makes GQM+ Strategy Approach unique is the way in which it links software for enabling business and that software development project. The strategic goal that an organization is trying to achieve is its business goal; the approach specified by activities in order to achieve the business goal is its strategy.

The Goal Structuring Notation (GSN) (Kelly, 1998) had been used to organize discussions concerning system dependability by structuring them in the form of goals (claims), strategies, assumptions (contexts), and rationales (evidence, solutions). Using the same structure as GSN, Yamamoto (2016b) proposed the BGSN approach to decompose business goals into sub-business goals using the strategy node. The context node is then used to describe rationales for decomposing the goals, such as perspectives, activity procedures, issue status, and the like. CSFs for the business goal are described in the bottom claim, and evidence nodes are used to describe achievements related to KPI values in order to achieve the CSF's. In this way, the BGSN approach employs GSN as is, while also adopting node descriptions for business goals.

1.4 Enterprise Architecture Modeling

Yamamoto et al. (2018b) proposed a method to visualize Jobs Theory, proposed by Christensen et al. (2016), using ArchiMate. They integrated the Jobs Theory and the goal oriented requirements model by using ArchiMate. Moreover, a case study for applying MBJT to an e-Healthcare use case was described. The meta-model of MBJT has also been proposed. Zhou et al. (2019) proposes an approach for business innovation using EA models.

Iacob et al. (2012) described a method to design business strategy by using ArchiMate. Iacob et al. (2014) also proposed a mutual transformation method between EA model and business models. Braun et al. (2015) proposed an extension method of the EA model by using meta model and profile. Cartero et al. (2016) proposed a compositional method to compose a federated business model based on ArchiMate, e3value, and BMC (Business Model Canvas) by using a meta model. Ahsan et al. (2010) proposed a visual approach to describe healthcare activities. Meertens et al. (2012) proposed a mapping between ArchiMate and BMC by using business ontology. Yamamoto (2016a) derived business models in ArchiMate based on actor relationships. Yamamoto et al. (2018a, 2018b) proposed a visual Jobs Theory based on ArchiMate.

EA has also been used to model healthcare business services. For example, Sharaf et al. (2017) discussed EA in the mobile healthcare cloud service domain. Yamamoto and Zhi (2019) defines business model patterns using ArchiMate. Hinkelmann et al. (2016) proposed an EA Ontology for business IT alignment. Kitsios and Kamariotou (2018) studied the Business Strategy Modelling based on Enterprise Architecture. They showed that the most frequently reported business modeling languages are the Archimate and the i* framework, which optimize concepts such as vision, mission, goals and strategy.

ArchiMate categorizes the phases of the Open Group's TOGAF Architecture Development Method (ADM) into three groups—(a) the ArchiMate core, (b) the Motivation extension, and (c) the Implementation & Migration extension, and it links them using the ArchiMate modeling language, as shown in The Open Group (2017). Wierda (2014) describes an introduction of ArchiMate. The ArchiMate core provides a modeling language for describing business architectures, information system architectures, and technology architectures. The Motivation extension provides a modeling language for describing preliminary, architecture vision, architecture change management, and requirements management phases. The Implementation & Migration extension provides a modeling language for describing opportunities and solutions, migration planning, and implementation governance. Walters and Plais (2017) showed a mapping from ArchiMate to BMM (Business Motivation Model) specified by OMG (2015). Although BMM defines the core concepts of business means, end, influencer and assessment, it did not provide visual symbols for these concepts.

Gomes et al. (2017) proposed a method to support business continuity process by using ArchiMate. Yamamoto, Olayan and Morisaki (2018a) suggested the representation levels of EA model might be used to compare the capability of models. This paper uses the representation levels to compare business modeling notations.

The rest of the paper is organized as follows. The comparison framework is proposed in section 2. Section 3 shows a result of the comparison of Business Model Notations using the proposed approach. The effectiveness, novelty and limitations are discussed in section 4. Finally, section 5 concludes the paper.

2. Method

To compare Business Model Notations, we define the key features according to five interrogatives and representation levels.

2.1 The Features of Business Model Notations

Business model describes key elements of businesses. The role of the business model is to capture the economic value of the new technology such as the e-Health solution. We identified the fifteen feature elements using five Interrogatives as shown in Table 1.

Table 1. Key Features of Business Model Notations

Interrogatives	Who	Why	Where	What	How
Features	Provider	Concerns	Problem	Asset	Business process
	Partner	Goal	Cause	Product	Customer relationship
	Customer	Value chain	Channel	Information	Cost structure

2.1.1 Who

The "Who" column of Table 1 describes the active actors of the business models. The active actors are the provider, partner, and customer. An example question to ask "Who" feature is who are the key actors of the business model?

The feature examples of the elderly emergency service are as follows.

Provider: Healthcare service provider

Partner: Doctor, Nurse

Customer: Elder person

2.1.2 Why

The "Why" column of Table 1 describes the motivation elements of the business models. The motivation elements are the concerns, goal, and value chain. The concerns show the reasons to create the business goals. The value chain describes the reason why the business succeeds. An example question to ask "Why" feature is why the business model is needed?

The feature examples of the elderly emergency service are as follows.

Concerns: Health and safety

Goal: Safe and secure anytime, anywhere

Value chain: Value exchange flow of actors

2.1.3 Where

The "Where" column of Table 1 describes the situations of the business models. The situation elements are the problem, cause, and channel. The problem shall be resolved by analyzing the cause. The channel shows the means to provide the solution. An example question to ask "Where" feature is where the business model is used?

The feature examples of the elderly emergency service are as follows.

Problem: The number of elderly people who are concerned about medical care and nursing care is increasing rapidly.

Cause: Emergency call is difficult anytime, anywhere.

Channel: Home security service channel.

2.1.4 What

The "What" column of Table 1 describes the passive elements of the business models. The passive elements are the asset, product, and information. An example question to ask "What" feature is what

are contained in the business model?

The feature examples of the elderly emergency service are as follows.

Asset: Operation center, Nurse

Product: Smart device for emergency call

Information: Customer contract, Emergency call record

2.1.5 How

The "How" column of Table 1 describes the behavior of the business models. The behavior elements are the business process, customer relationship, and cost structure. An example question to ask "How" feature is how does the business model work?

The feature examples of the elderly emergency service are as follows.

Business process:

Customer relationship: Emergency response

Cost structure: Smart device development and maintenance cost, Operation center expenses

2.2 Representation Levels of Business Model Notations

The five representation levels of notations are defined as follows:

4: the feature is symbolized by a corresponding visual icon.

3: the feature is visualized by using a visual node.

2: the feature is identified by a specific label.

1: the feature is indirectly described.

0: there is no means to describe the feature.

3. Result

In this section, we compare the business value, business goal and EA based modeling notations. BMC, CVCA, and e3Value are selected as the business value based modeling notations. BSC, BGSN, GQM+ Strategy, i*framework, and ARM are selected as the business goal based modeling notations. MBJT and ArchiMate are selected as the EA based modeling notations. Above mentioned Business Model Notations are compared below using the comparison framework described in section three.

The representation levels for BMC, CVCA, e3Value, BSC, BGSN, GQM+ Strategy, i*framework, ARM, MBJT, and ArchiMate are evaluated as follows.

BMC provides specific labels for the partner, asset, channel, cost structure, value chain, business process, goal, customer relationship and customer segment. However, BMC did not provide notations for the problem, cause, concerns, product, and information.

CVCA provides visual symbols for the provider, partner and customer. CVCA also provides specific labels for the channel, cost structure, value chain, business process, customer relationship, product and information. However, CVCA did not provide notations for the problems, cause, concerns, asset, and goal.

e3Value provides visual symbols for the concerns, channel, provider, partner and customer. e3Value also provides specific labels for asset, cost structure, value chain, business process, customer relationship, product and information. However, e3Value did not provide notations for the problems, cause, and goal.

BSC provides visual symbols for the goal. BSC also provides specific labels for the cost structure, business process, customer relationship, and customer. BSC can indirectly describe concerns, channel, provider, partner and asset. However, BSC did not provide notations for the problems, cause, value chain, product and information.

BGSN provides the visual symbol for the goal. BGSN can indirectly describe the problem, cause, concerns, provider, partner, customer, customer relationship, asset, channel, value chain, cost structure, and business process. However, BGSN did not provide notations for the product and information.

GQM+ Strategy can describe the cost structure by using the visual node. GQM+ strategy also provides labels for the problem, concerns, provider, partner, business process, goal, and customer. However, GQM+ strategy did not provide notations for the cause, asset, channel, value chain, customer relationship, product and information.

i*framework provides symbols for the provider, partner, asset, business process, goal and customer. i*framework also provides visual nodes for the concerns, cost structure, channel, value chain, customer relationship, product and information. However, i*framework did not provide notations for the problem and cause.

ARM provides actor labels for the provider, partner, and customer. ARM can indirectly describe the problem, cause, concerns, asset, channel, cost structure, value chain, business process, goal, customer relationship, product and information.

MBJT provides symbols for the problem, cause, provider, customer, goal, and product. MBJT also provides visual nodes for the concerns, channel, value chain, business process, and customer relationship. However, MBJT did not provide notations for the partner, asset and information.

ArchiMate provides symbols for the problem, cause, provider, partner, asset, channel, business process, goal, customer relationship, product and information. It also provides visual nodes for the concerns, cost structure, and value chain.

Table 2 shows the result of comparison using the comparison framework in Table 1. The values in Table 2 are the representation level values for the corresponding feature categories. For example, the Interrogative representation levels of BMC are (6, 4, 2, 2, 6) in Table 2.

The result shows that ArchiMate is the most powerful Business Model Notation in the comparison.

Table 2. Key Features of EA Frameworks

Interrogatives	Who	Why	Where	What	How
BMC	6	4	2	2	6
CVCA	12	2	2	4	6
e3Value	12	6	4	6	6
BSC	4	5	1	1	6
BGSN	3	6	3	1	3
GQM+ Strategy	6	4	2	0	5
i*framework	12	10	3	10	10
ARM	6	3	3	3	3
MBJT	8	10	11	4	6
ArchiMate	12	10	12	12	11

Let X and Y are as Business Model Notations. X>Y if every feature of X is not smaller than those of Y. For example, the features of ArchMate and ARM are (12, 10, 12, 12, 11) and (6, 3, 3, 3, 3), respectively. Therefore, ArchiMate>ARM.

The following expression is derived from the Table 2.

ArchiMate>MBJT, i*framework>e3Value>ARM, (BMC>GQM+Strategy), BGSN, BSC, CVCA

Based on the above expression, Figure 1 shows the representational power lattice. The representation power of the upper notations is greater than those of the lower notations in Figure 1.

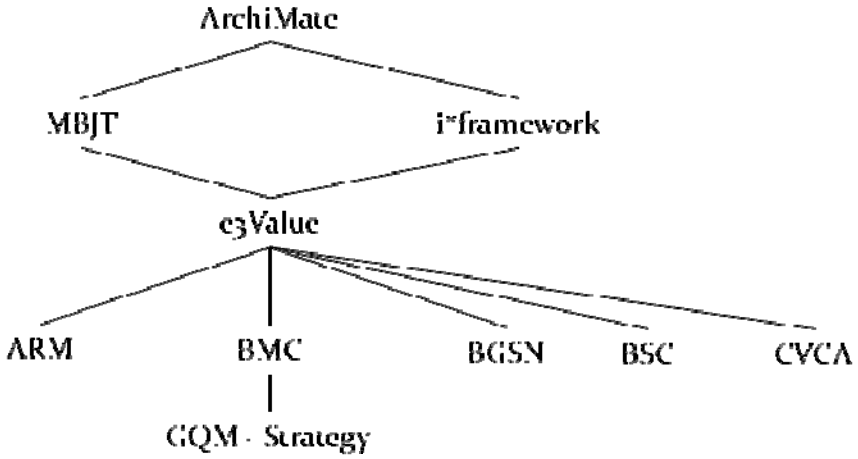

Figure 1. Representational Power Lattice of Business Modeling Notation

4. Discussion

This section discusses the effectiveness, novelty and limitations of the proposed comparison approach.

4.1 Effectiveness

The proposed the comparison framework is effectively applied to compare Business Model Notations. As the comparison task is achieved by counting feature elements based on the five categories, it is easy and concrete. There is no ambiguous decision on the way to evaluate features of Business Modeling Notations.

The features of the comparison framework will be used to clarify the relationship between different Business Modeling categories as shown in Figure 2. For example, the features of Business Value Modeling are covered by those of Business Goal Modeling. Business Architecture Modeling includes all the features of Business Modeling Notations. Figure 2 also clarifies the difference between Business Process Modeling and Business Value Modeling.

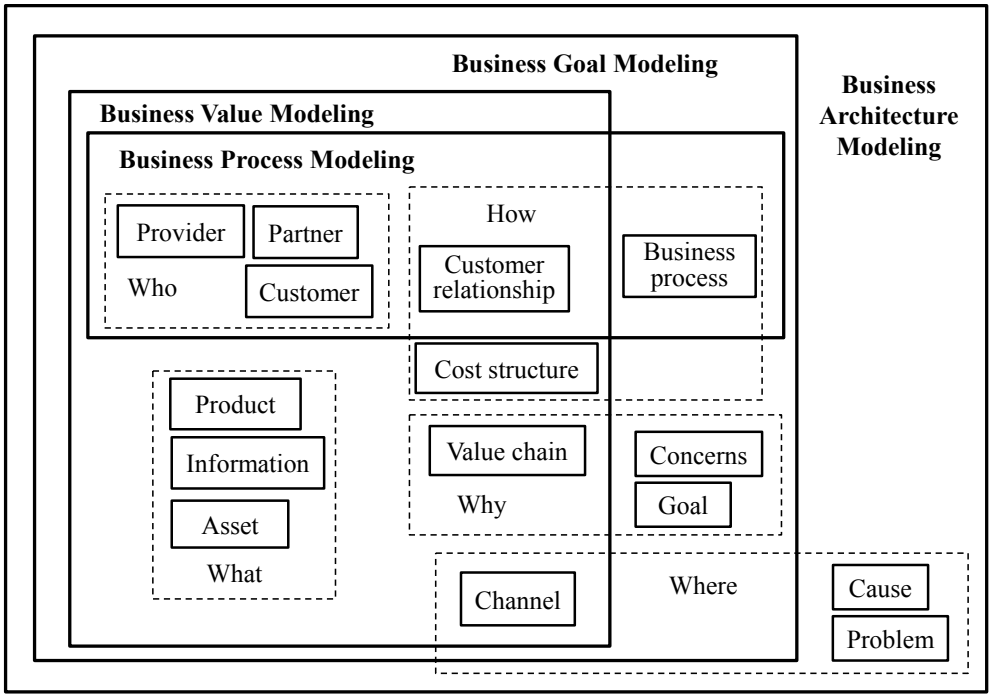

Figure 2. Comparison of Business Modeling Notation Category

4.2 Novelty

So far, Business Modeling Notations had been individually compared by different authors. Therefore, there is no common evaluation framework for comparing different Business Modeling Notations. The proposed comparison framework consists of the objective fifteen features from five interrogatives. We also introduced the descriptive levels of features in the proposed comparison framework for the first time. The past Business Modeling comparison literatures did not consider the description level that is the simple capability evaluation mechanism for Business Modeling Notations.

As we show that the interrogative view of the Business Model features provides a useful clues for stakeholders who want to understand and make decisions on Business Models. Using Figure 2, stakeholders can easily to choose the appropriate Business Model Notations based on interrogatives.

4.3 Limitations

The number of compared Business Modeling Notations is ten. It is necessary to compare other Business Process Modeling Notations, such as BPMN, DEMO and URN. We intentionally omitted these Business Process Modeling Notations, because these Notations did not have features than "Who" and "How" features.

The comparison framework only contains conceptual elements. It does not contain the criteria for the relationships between elements. The comparison framework also omits the criteria such as understandability, quality of models, and productivity to develop models. These criteria are difficult to evaluate objectively. Therefore, different research approaches using case studies might be needed. Moreover, as intuitive opinions of practitioners shall be necessary to evaluate these qualitative criteria. The result depends on the expertise of practitioners who use Business Model Notations.

5. Conclusion

This paper proposes a comparative framework of Business Model Notations based on the five interrogatives. The comparison framework consists of the fifteen features as shown in Table 1.

The characteristic of the comparative framework is objectively able to evaluate Business Model Notations.

The meaning of the model that has been built as Figure 2 is as follows:

Business Modeling Notations can clearly be categorized by using the interrogative based feature framework. The optimal Business Model Notation can also be chosen from the necessary set of interrogatives using Figure 2. In other words, if we select an interrogative set, the appropriate Business Model category will be decided. For example, the interrogative set "Who" and "What" is selected, the appropriate Business Model category is the Business Value Modeling. Of course, we can use Business Goal and Business Architecture Modeling of the interrogative set. However, the Business Value Modeling is the minimal model for the interrogative set. In this way, Figure 2 implies fruitful considerations on comparing Business Model Notations.

The future work includes: 1) to extend the dimensions of the comparative framework towards interrelationships among the elements, 2) to evaluate other Business Model Notations using the proposed approach, and 3) to develop a transformation method between Business Model Notations using the comparison framework.

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