

A Consideration on MaaS Service Models using ArchiMate

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Abstract

The Mobility as a Service (MaaS) provides seamless transportation from the current location to the destination. MaaS has been in operation in Finland and it is now in Japan as well the development of MaaS applications had been evolving. For developing MaaS applications, it is necessary to combine business models, user experience notations, and service architecture models. So far, such integrated MaaS service development model is unknown.

In this paper, we propose a hierarchical MaaS service model to combine business model canvas, customer journey map and business architecture using ArchiMate. Moreover, we show the effectiveness of the proposed model by applying the model to a MaaS application in Japan.

1. Introduction

As the MaaS service model has become popular all over the world, it has also been introduced in Japan as well. In this paper, we show some issues that exist in the current situation and their improvement plans for the realization of MaaS in Japan. This paper proposes the hierarchical MaaS service model by using diagrams in ArchiMate.

In the following, we first describe related work in Section 2. Section 3 proposes a hierarchical MaaS service model using

ArchiMate, and Section 4 describes an example case study of the proposed model. Section 5 discusses the discussion, and Section 6 summarizes and discusses future issues.

2. Related Research

In the following, we describe related work on MaaS service design.

2.1 Services

In SEBoK (Systems Engineering Body of Knowledge) Part 4, Pineda and Lawson define services as follows[1].

[Definition]

Service is an activity that changes the state of an entity (individual, person, product, business, region, nation) according to the conditions mutually agreed between the service provider and the customer.

The developed service and/or set of services accessible to the customer (consumer or business) is realized by the service system.

SEBoK (Service Engineering Body of Knowledge) points out that the goal of a service or business is an entry point for analyzing business architecture (including organizations and processes), and that coordination between IT components and technology architecture is necessary to achieve the goal.

Arai et al. [2-5] defined a service as an action or a chain of actions in which a service provider causes a state change desired by a service beneficiary for a fee. They also defined "service engineering" as a system for expressing, analyzing, evaluating, and designing services.

Bullinger et al. defined service engineering as "a technical principle to systematically develop and design services using appropriate models, methods, and tools"[6].

Morelli et al. [7] listed IHIP (Immaterial, Heterogeneous, Inseparable, Perishable), i.e., intangibility, heterogeneity, non-separability, and perishability, as the characteristics of services. In addition, he defined a service logic hierarchy consisting of 1) service as interaction, 2) service as infrastructure, and 3) service as systemic institution. The logical hierarchy of services is defined as follows.

2. 2 MaaS

Since MaaS is a new service that is currently under development, there is no clear definition even in foreign countries that are ahead of us.

Generally speaking, it is a new concept of mobility that seamlessly links all modes of transportation other than the personal car as a single service [8].

The MaaS Alliance, established in 2015, states that "MaaS is the integration of various transportation services into a single mobility service that can be used according to demand"[9].

Researchers [10] at Chalmers University in Sweden divide it into four stages according to the degree of integration. The four integration levels are 1) Social goals, 2) Service offerings, 3) Booking & Payments, and 4) Information.

2. 3 ArchiMate

ArchiMate is an EA modeling language standardized by The Open Group [11]. ArchiMate was developed from 2002 to 2004 in a Dutch industry-government-academia collaborative project. It was then standardized as an EA modeling language by The Open Group, and ArchiMate 1.0 was released in 2009. The latest version is ArchiMate 3.1, released at the end of 2019[12]. The Open Group is conducting the ArchiMate certification exam and has certified about 10,000 people worldwide by 2019.

ArchiMate can describe all the deliverables of the Architecture Development Method (ADM) of TOGAF (The Open Group Architecture Framework) [13]. TOGAF is the

most feature-rich EA framework [14].

Janssen et al. have pointed out that ArchiMate is effective for creating service networks [15]. A comparison of business model notations shows that ArchiMate has the highest expressive power [16].

3. Proposed Hierarchical MaaS Service Model

In designing a hierarchical MaaS service model, we propose a method which consists of the following six layers, i.e., 1) Issues, 2) Business model, 3) UI(User Interface), 4) Service, 5) Digital Twin, and 6) Collaboration as shown in Table1.

Table 1 Hierarchical MaaS service model

Issue layer	Define comprehensive solutions for diverse MaaS issues
Business model layer	Define business value with BMC for each user segment
UI layer	Define service user interface
Service layer	Define application services such as mobility, payment, accommodation
Digital Twin layer	Define service information data
Collaboration layer	Define external information collaboration to realize services

4. Example Case Study

4.1 Target Service

As a target service to apply our proposed method, we consider "CentX", a MaaS application provided by Meitetsu Corporation.

CentX is a digital platform for connecting transportation, living, and sightseeing services mainly in Aichi and Gifu prefectures, and has functions such as multi-modal route search [17].

4.2 Approach of the case study

In the case study, we analyze the current CentX applications, and found new MaaS

applications which has not been in existing CentX. These new applications may show future application candidates of CentX.

In our case study, we try to add new service models for tourists in addition to the existing CentX MaaS service.

4.3 Business Model

The BMCs for tourists and accommodation facilities users are shown in Fig.1 and Fig.2, respectively.

KP キーパートナー タクシー会社 カーシェア会社 シェアサイクル会社 主に名鉄G	KA 主要活動 移動手段の一括予約・一括決済 一括対象サービスとの連携(主に名鉄G) 定期的な不具合・バグ修正 KR 主なリソース タクシー会社・カーシェア・シェアサイクル等 名鉄Gの連携コンテンツ 名鉄GのIT開発・運用能力 広域能力 名鉄Gのホテル・観光施設	VP 価値提案 スムーズな移動体験 移動手段の一括予約 利用履歴に基づく 予約の自動提案	CR 顧客との関係 移動時対応 予約の相談 CH チャネル HP パンフレット CM 名鉄の駅構内のポスター広告、駅番機、デジタルサイネージ CentX 2nd 顧客からの口コミ	CS 顧客セグメント アプリユーザ (横浜からの日本人観光客)
CS コスト構造 開発・運用コスト (人件費) 設備維持管理経費 固定経費	RS 収益の源 サービス手数料、一括予約での予約に対するサービス手数料 キーパートナーから広告掲載料			

Fig1. BMC (Tourist user)

KP キーパートナー タクシー会社 カーシェア会社 シェアサイクル会社 主に名鉄G	KA 主要活動 CentXとの連携 CentX・名鉄Gの宣伝 定期的な不具合・バグ修正 KR 主なリソース 自社施設 CentX 名鉄Gの連携力 データ分析能力 AI開発人材	VP 価値提案 新規顧客獲得 既存顧客のリピーター (利用履歴に基づく、 予約の自動提案) 顧客の満足度向上	CR 顧客との関係 予約の相談 CH チャネル 法人営業	CS 顧客セグメント 名鉄イン株式会社 (さらなる顧客獲得を 望むホテル業系名鉄G)
CS コスト構造 開発・運用コスト (人件費) 設備維持管理経費 固定経費	RS 収益 (勘定) 新規顧客獲得により収益が40%拡大 参考: https://partner.booking.com/ja%E3%82%B0%E3%83%AA%E3%83%A5%E3%83%BC%E3%82%B7%E3%83%A7%E3%83%B3genius%E3%83%B7%E3%83%AD%E3%82%B0%E3%83%A9%E3%83%A0-Q			

Fig2. BMC (Accommodation user)

4.4 Architecture

Using ArchiMate, we illustrate the whole business architecture of the MaaS service design in Fig.3. Fig.4 describes problems, causes and goals to solve them.

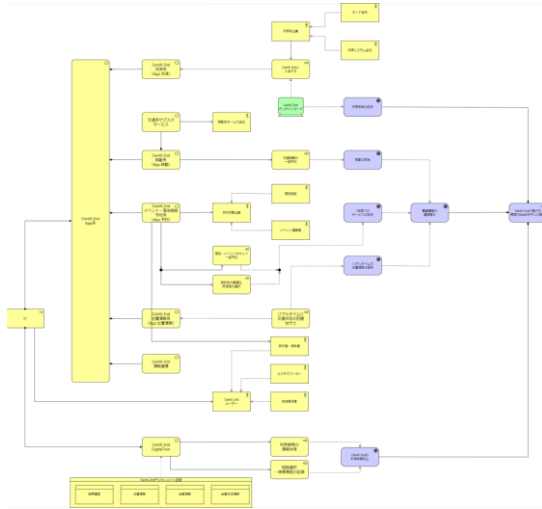


Fig3. Business Architecture

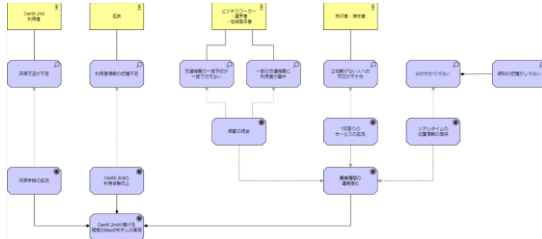


Fig4. Problem Solving Analysis

4.5 Digital Twin

The value analysis table for digital twin users is shown in Table2. In addition, an overview of the Digital Twin service is illustrated using ArchiMate in Fig.5.

Table2. Digital Twin Value Analysis Table

Element	Explanation
Customer	MaaS application users
Concerns	Better user experience
Pain point	Insufficient user interaction and information exchange Insufficient gathering and analysis of usage log
Cause	Omission of information exchange function among users
Goal	Realtime information exchange among users
Solution	Digital Twin service to exchange information among users
Problem solving	Digital Twin usage reservation
Realization	Digital Twin usage

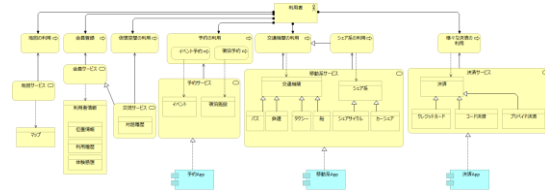


Fig5 Digital Twin

4.6 User Interface

The UI is a platform for users to use the 5 proposed method. Therefore, we add some accommodation related features that were not included in the existing MaaS applications.

4.7 Collaboration

The CJM (Customer Journey Map) of information collaboration is shown in Fig.7 by using ArchiMate. The collaboration engine gathers external open information necessary to transit to other transportation services for passengers.

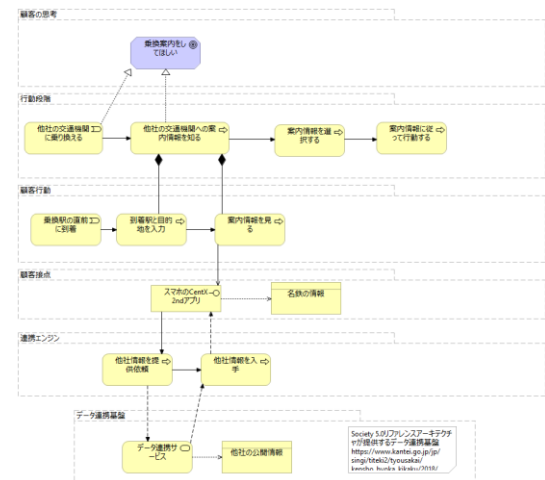


Fig6. CJM (Interfacing Engine)

4.8 Mobile Services

Using ArchiMate, we construct a CJM and illustrate the behavior of customers in mobile services as shown in Fig.7.

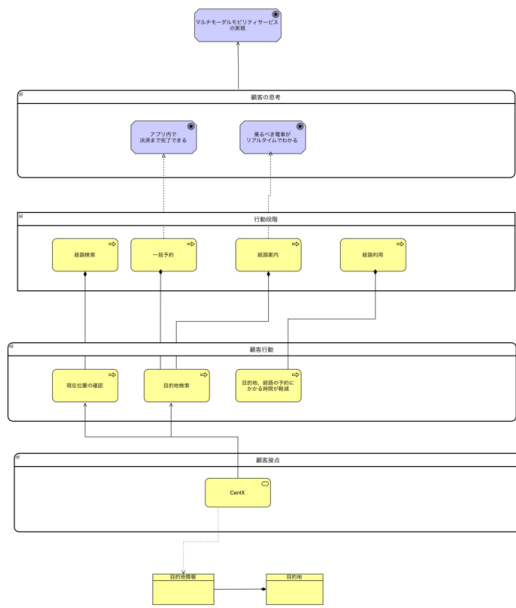


Fig7. CJM (Mobile Services)

4.9 Payment Service

The CJM for the customer behavior in a payment service is shown in Fig.8 by using ArchiMate.

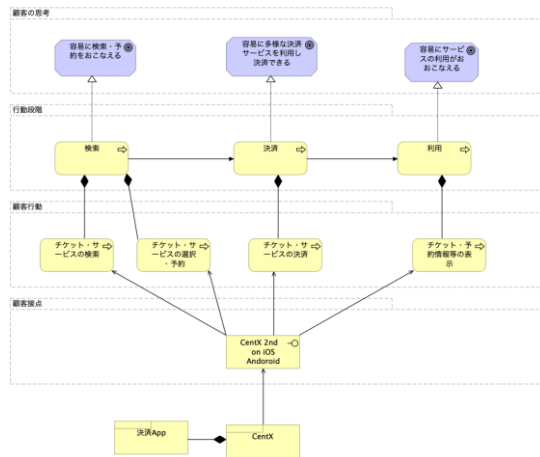


Fig8. CJM (Payment Service)

4.10 Accommodation Service

The CJM of the customer behavior in accommodation service is shown in Fig.9 by using ArchiMate.

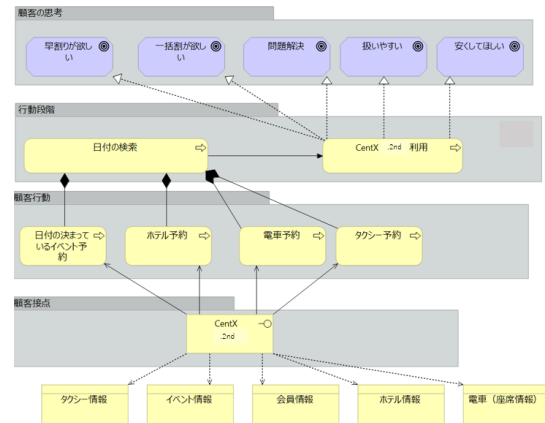


Fig9. CJM (Accommodation Services)

5. Consideration

In this section, we discuss the effectiveness and limitations of the proposed method.

5.1 Effectiveness

The existing MaaS service can be extended by applying the proposed hierarchical MaaS service model as described above.

The conventional MaaS service model is limited on the integration capability, although it should be integrated different interrelated concerns [10]. For example, customers are limited to local users, and it does not directly lead to the acquisition of new customers.

As shown above, the proposed method integrates several new MaaS applications through the six layered architecture. Accommodation and tourist service facilities are described in the case study. This approach can attract new customers and revitalize local industries.

5.2 Limitations

The proposed method only shows a possible MaaS service model in the future, and there are still various issues such as the mutual relationship among stakeholders when it is

realized. In this paper, we also analyze a hierarchical MaaS service model using ArchiMate, which enables us to relate KA, VP, CR and CJM in BMC. However, the other elements of BMC are not represented, although BMC can be represented by ArchiMate. For example, Meertens et al. [18] proposed a mapping between ArchiMate and BMC by using business ontology.

6. Conclusion

In this paper, we propose a new MaaS service model and clarify the effectiveness of the proposed method by applying it to an existing MaaS service model. In the proposed method, CJMs are created by ArchiMate as a method of analyzing MaaS service models. The results showed that ArchiMate is useful for the analysis of service models because it enables us to relate key items of the BMC to the CJM, which has not been observed in the conventional service model analysis approaches.

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References

- [1] Ricardo Pineda, Bud Lawson, Fundamentals of Services, SEBoK Part4 Application of Systems Engineering, https://www.sebokwiki.org/wiki/Fundamentals_of_Services
- [2] 新井民夫, 下村芳樹, サービス工学: 製品のサービス化をいかに加速するか, 一橋ビジネスレビュー, 54 巻 2 号, p.51-69, 2006
- [3] 下村 芳樹, 新井 民夫, サービス工学におけるオン

- トロジー中心設計の展開, 人工知能学会誌, 2008 年 23 巻 6 号 p. 721-727
- [4] 下村芳樹, サービスの設計論-要素の設計から関係の設計へ-, 横幹第 4 巻第 2 号, 2010, pp.74-80
- [5] 新井民夫, サービス工学の提案-製品のサービス化-, 精密工学会誌, Vol.78, No.3. pp.179-184, 2012
- [6] Hans-Jörg Bullinger, Klaus-Peter Fähnrich, Thomas Meiren, Service Engineering – Methodical Development of New Service Products, International Journal of Production Economics, 2003, vol. 85, issue 3, 275-287
- [7] Morelli, N., An Approach to Service Design, Chapter2 in Nicola Morelli, Amalia de Götzzen, Luca Simeone, Service design capabilities, pp.9-26, Springer, 2021
- [8] 国土交通省 国土交通政策研究所, モビリティクラウドを活用したシームレスな移動サービスの動向に関する調査研究
- [9] MaaS Alliance, White Paper, September 4, 2017
- [10] Jana Sochor, Hans Arby, Marianne Karlsson, Steven Sarasini, A topological approach to Mobility as a Service: A proposed tool for understanding requirements and effects, and for aiding the integration of societal goals, Conference: 1st International Conference on Mobility as a Service (ICOMaaS) ,2017
- [11] 山本修一郎,現代エンタープライズ・アーキテクチャ概論 - ArchiMate 入門, デザインエッグ社, 2016
- [12] The Open Group, ArchiMate® 3.1. Specification. C197. 2019
- [13] The Open Group, TOGAF v9.2, C182, 2018
- [14] Wil Janssen, Marc Lankhorst, Timber Haaker, and Henny de Vos, From Service Innovation to Service Engineering, in Cloud Computing and Services Science, New York: Springer, 2012, pp. 33-51.
- [15] Yamamoto S. et al., Another Look at Enterprise Architecture Framework, Journal of Business Theory and Practice, 2018
- [16] Shuichiro Yamamoto, A Comparative Analysis of Business Model Notations, Journal of Business Theory and Practice, Vol. 7, No. 3, 2019, pp. 111-123
- [17] 名鉄 CentX, CentX | 名古屋鉄道 (meitetsu.co.jp)
- [18] Meertens, L., Iacob, M., Jonkers, H., & Quartel, D. (2012). Mapping the Business Model Canvas to ArchiMate. In *SAC'12* (pp. 1694-1701). <https://doi.org/10.1145/2245276.2232049>