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THEORETICAL ARTICLE

# The identification of new service opportunities: a case-based morphological analysis

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**Abstract** Typically, firms try to differentiate their products through the integration of innovative services. For this reason, much recent research into new service development has focused on methods of identifying and generating new service ideas. The most prevalent method for generating a new service is a morphological analysis that decomposes a system into several dimensions and values, and then recombines those values to generate new services. Despite the popularity of morphological analysis, how to build morphological matrix has been an area of subjective expert judgment. In this paper, we focused on the possibility to utilize the big data to the morphological analysis to address the subjective morphological building process, by suggesting a case-based morphological analysis. By employing case-based reasoning and network analysis, firms can easily identify direct and indirect clues for the new services and integrate these results to the morphological building processes. To support this approach, this study first employs a case-based reasoning strategy to collect and identify similar services, and then assesses the patterns in those services through network analysis. By engaging in network analysis, firms can identify key aspects of new services, and determine what kinds of keywords or aspects should be employed for the dimensions and values of morphological matrices.

**Keywords** Case-based reasoning · New service generation · Morphological analysis · CBR · Service

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## 1 Introduction

With the rise of the smart era, services have come to no longer be simply considered additional or peripheral to products, and are instead seen as delivering core value to customers (Kandampully 2002; Geum et al. 2011a). Firms thus try to differentiate their products by integrating innovative services into them (Geum et al. 2011a). This is especially true in contemporary business environments, where smartphones provide strong platforms for realizing many innovative smart services (Allmendinger and Lombreglia 2005; Stroulia 2010; Kim et al. 2014).

As a result of these developments, firms face some important questions to deal with fierce environment. The most prominent issues are related to the generation of innovative ideas and identification of new services. The following questions should be posed:

– *Framework* How can firms identify new and innovative service ideas?
– *Data* From where can firms get new and innovative ideas?
– *Method* How can firms integrate these data sources and expert judgment?

To answer these questions, much of the recent research into new service development has focused on methods of identifying and generating new service ideas (Kim et al. 2008; Lee et al. 2009; Geum et al. 2015a, b). The most prevalent method for generating a new idea is a morphological analysis that decomposes a system into several dimensions and values and recombines them to generate new ideas (Weber and Condoor 1998; Yoon and Park 2005; Kim et al. 2008; Ölvander et al. 2009; Geum et al. 2011b; Yoon et al. 2014). Despite the popularity, however, much debate is still going on about how to develop the morphological matrix. The morphological analysis has relied on subjective building methods, and simply employed the opinions of several experts (Weber and Condoor 1998; Kim et al. 2008; Lee et al. 2009; Ölvander et al. 2009; Geum et al. 2011b).

However, with the rise of the big data era, much of the literature continues to emphasize the new chances in building morphological matrix. Recently, a substantial amount of data has been generated and consumed, thus effective use of these data can therefore be a great source of new services (LaValle et al. 2011). However, with the subjective approach to morphological analyses, the chances of arriving at new and innovative services are limited. This is especially true where service innovation is incremental, and services are refreshed or renewed by minor changes (Gallouj and Weinstein 1997; Van der Aa and Elfring 2002; Geum et al. 2015b). Therefore, collecting a database from previous services and identifying similar services from it might be very helpful to new service generation.

To address this circumstance, this paper introduces a case-based module to the traditional morphological analysis by integrating case-based reasoning. Case-based reasoning is a method for identifying similar cases within an existing database and reusing the selected cases to generate new ideas (Aamodt and Plaza 1994; Wu et al. 2008). The use of case-based reasoning is helpful for building new morphological matrixes, by identifying similar cases and their means of generating new ideas.

However, even if case-based reasoning can provide important clues to the new service generation based on the identification of previous similar cases, another challenge still remains—how to support the building process of morphological matrix. More specifically, it still remains a void in the literature how to identify dimensions and values of morphological analysis. In fact, identifying dimensions and corresponding values is critical to the success of new service generation (Geum et al. 2015a). For example, if a new product is developed based on a certain morphological matrix whose dimensions are design, color, and material, new products generated from the morphological analysis will be limited by these three dimensions. Therefore, identifying the dimensions that represent the key characteristics of products and services is a must for generating new service ideas. To address this issue, this paper also employs a network analysis for the similar cases identified through case-based reasoning. By engaging in network analysis, firms can identify key aspects of new services (Kim et al. 2014) and determine what kinds of keywords or aspects should be employed for the dimensions and values of morphological matrixes.

The remainder of this paper is organized as follows. The related works section deals with the background of industry convergence, which is the key theme of this paper. The research framework section then addresses the overall process and detailed procedures, along with the data used in this research. The subsequent case study section presents how the proposed approach is applied in practice. Finally, a summary of this study and its limitations is provided in the conclusion.

## 2 Related works

### 2.1 New service generation

Since today's market environment is one of increasingly fierce competitions, firms have to constantly consider their next new businesses. As such, the identification of new ideas for innovation is critical. This is especially true with the rise of service innovations that regard services as key factors for innovation, because manufacturing and service firms are now both seeking to identify new service ideas. IBM already transformed their business model from manufacturing and selling the computer equipments and software to providing relevant services for their competitive advantages (Spohrer and Maglio 2010; Barrett et al. 2015). This trend has not only affected practice, but literature as well, with many scholars paying great attention to the generation of new service ideas.

Early research into new service development has focused on the models, frameworks, and processes for development, and on differentiation from product development. Edvardsson and Olsson (1996) have discussed key concepts for new service development based on empirical studies in Sweden, and suggest that adopting an efficient customer process is critical to attaining the desired service quality. More recent studies focus on various aspects of service innovation such as customer involvement and customer co-creation (Gustafsson et al. 2012), service ecosystem (Basole and Karla 2012), and smart service system (Allmendinger and Lombreglia

2005; Stroulia 2010). Gustafsson et al. (2012) analyzed the impact of customer co-creation in service innovation based on four dimensions of communication: frequency, direction, modality, and content. Matthing et al. (2006) denoted the role of innovative users to develop new technology-based services. In those services, lead users or users with high technology readiness can play an important role in service innovation. Another important recent research on service innovation is related to the mobile service ecosystem which has been received a great attention by the emergence of smartphones, mobile network infrastructure, and mobile service applications (Basole and Karla 2012). Finally, with the emergence of smart era, studies on smart service system have been also an important research area in service innovation. The work by Allmendinger and Lombreglia (2005) noted the definition of smart services, focusing on user-centered, connected, and preemptive characteristics. In this study, the concept of machine intelligence was emphasized to understand the smart services. Similarly, the study by Halloran (2012) also emphasized the role of information technology (IT) to characterize the smart service innovation. Based on three foundations—big data, cloud computing, and intelligent system—smart services can provide value to customers (Halloran 2012; Geum et al. 2015b).

Another stream of new service development focuses on the methods and tools for generating new service ideas. In related studies, the generation of hands-on service ideas has become a critical question. With this purpose in mind, many different methodologies for guiding new idea generation have been actively employed, including case-based reasoning (Wu et al. 2006; Geum et al. 2015b), theory of inventive problem solving (TRIZ) (Chai et al. 2005; Zhang et al. 2005), map-based approach (Son et al. 2013; Lee and Lee 2015), quality function deployment (QFD) (Yu and Kwak 2015; Cheng et al. 2015; Cho et al. 2015), and morphology analysis (Kim et al. 2008; Lee et al. 2009; Geum et al. 2011b). The use of such methodologies can lead to more systematic and well-organized new services by employing well-defined methodologies. In much research, the use of methods is not subject to a single methodology. Instead, many studies try to integrate related methods for new service generation, in order to maximize effectiveness.

### 2.2 Case-based reasoning

Under the dominant approach of incremental innovation in service industries, new services are frequently being generated from existing ones (Gallouj and Weinstein 1997; Van der Aa and Elfring 2002; Geum et al. 2015b), and so analyzing current or previous services should be considered an important task. Case-based reasoning suits such purposes (Recio-García et al. 2014). Case-based reasoning is a problem-solving paradigm that automates reasoning and machine learning by remembering previous similar situations and reusing them (Aamodt and Plaza 1994; Recio-García et al. 2014). Similar past cases are identified and reused to suggest solutions for new situations, based on five sequential processes: presentation, retrieval, adaptation, validation, and update (Aamodt and Plaza 1994).

The idea behind case-based reasoning is that any problem can be resolved by investigating similar previous cases and modifying and reusing the applied solutions. Theoretically, a case-based reasoning system involves three components: a case representation scheme that considers the case as a model composed of several attributes that are employed as evaluation criteria, a similarity metric that measures the similarity between the current case and those in the database, and a case-retrieval mechanism for retrieving the cases that are most similar to the target problem (Wu et al. 2006).

Case-based reasoning has been employed in many different application domains. In idea generation literature, Wu et al. (2008) work employed fuzzy CBR approach for generating new product ideas. For this purpose, they developed a database where a product is encoded by a vector of consisting of 100 attributes, where 87 attributes are used to characterize the scenario of using the product and 13 attributes to describe the manufacturing and recycling features (Wu et al. 2008). Nagata et al. (2014) work applied the case-based reasoning system to solve the problem related to the regional science and technology policy. They compiled previous cases into a new database which enables the in-depth analysis of success factors of previous policies. Recio-García et al. (2014) proposed a framework and architecture for building case-based reasoning system and suggested four types of case-based reasoning (CBR): textual CBR where cases are given as a form of text, knowledge-intensive CBR which a rich domain model is available, data-intensive CBR where precedent cases are the main-source of information with no domain knowledge available, and finally, distributed CBR where different agents collaborate to solve a problem (Recio-García et al. 2014). Ahmed-Kristensen and Vianello (2015) suggested a framework to reuse service knowledge to the new innovation. Throughout personalization and codification process, knowledge is transferred from service engineer to engineering designers. In this work, they mentioned the use of case-based reasoning, especially focusing on the revise and retain.

Basically, case-based reasoning is a form of inductive reasoning. Inductive reasoning is generalization based on the observation of specific instances (Dong et al. 2015). Through the real-life observations, conclusions are derived as a form of proposition, and these instances are then used to establish generalized knowledge (Hyde 2000; Kovács and Spens 2005). The goal of inductive reasoning is to accumulate evidence to support or refute the hypothesis (Dong et al. 2015).

Mainly, the value of inductive reasoning can be self-evident from the value of the information, which means the cumulative practical observation can provide strong evidence for the generalization (Krumholz 2014). As more evidence in support of the premises become available, the degree of strength of the conclusions in inductive reasoning increases (Dong et al. 2015). This means the use of case-based reasoning can provide powerful conclusions in current environment where big data are generated and easily employed to the analysis.

### 2.3 Morphological analysis

The use of appropriate methods is a key factor in the effective generation of new services (Chai et al. 2005; Wu et al. 2006; Kim et al. 2008). At the core of this ideation method is morphological analysis (Yoon and Park 2005; Kim et al. 2008; Yoon et al. 2014). The general form of morphology analysis was developed as a method for structuring the total set of relationships contained in multi-dimensional, non-quantifiable, problem complexes, and this has been applied to diverse fields (Yoon et al. 2014). The basic idea of morphology analysis is that any subject can be broken down into some dimensions that clearly represent it (Yoon et al. 2014). Its strength lies in its ability to explain complex problems and generate new ideas based on creative combinations of dimensions (Yoon and Park 2005).

As it makes it possible to generate new and creative ideas, morphology analysis has been applied in many different areas, including new product development (Weber and Condoor 1998), new technology development (Yoon and Park 2005; Yoon et al. 2014), and new service development (Kim et al. 2008; Lee et al. 2009; Geum et al. 2011b). Recent studies of morphology analysis have also focused on incorporating other techniques to facilitate analysis, such as text mining (Yoon et al. 2014) and genetic algorithms (Lee et al. 2009). In particular, morphological analysis has been prominently employed as a tool for new service generation. Kim et al. (2008) have used a hybrid approach to morphological analysis and conjoint analysis to generate new service concepts. Geum et al. (2015a) have extensively used morphological analysis to generate new smart services. In their work, they consider the characteristics of smart services to develop two morphological matrixes: (service) context-driven morphology and technology-driven morphology. By integrating these two types of matrixes, new smart services can effectively reflect the innate characteristics of the term 'smart service.'

## 3 Research framework

### 3.1 Overall process

Figure 1 depicts the overall process involved in this paper. For this study, we have combined case-based reasoning and morphological analysis to generate new service ideas. The concept behind this process is that new service ideas can be generated based on the reuse and combination of existing services. This assumption is theoretically supported by previous literature, which shows that service innovation is generally incremental and services are typically refreshed or renewed by making minor changes (Van der Aa and Elfring 2002). Therefore, we first employ case-based reasoning to determine how existing services provide their functions and value to the customer, and then explore similar cases of services that are already provided to customers. These similar cases are analyzed to identify their key characteristics and dominant relationships. During this step, we employ network analysis and investigate network indicators to assess dominant relationships and keywords. We then use these dominant patterns to engage in a keyword-based morphological analysis.

### 3.2 Detailed procedures

#### *3.2.1 Defining requirements*

The first step in our process is to identify the problem or requirement involved. To generate new services, firms have to set up their goals for service specifications.

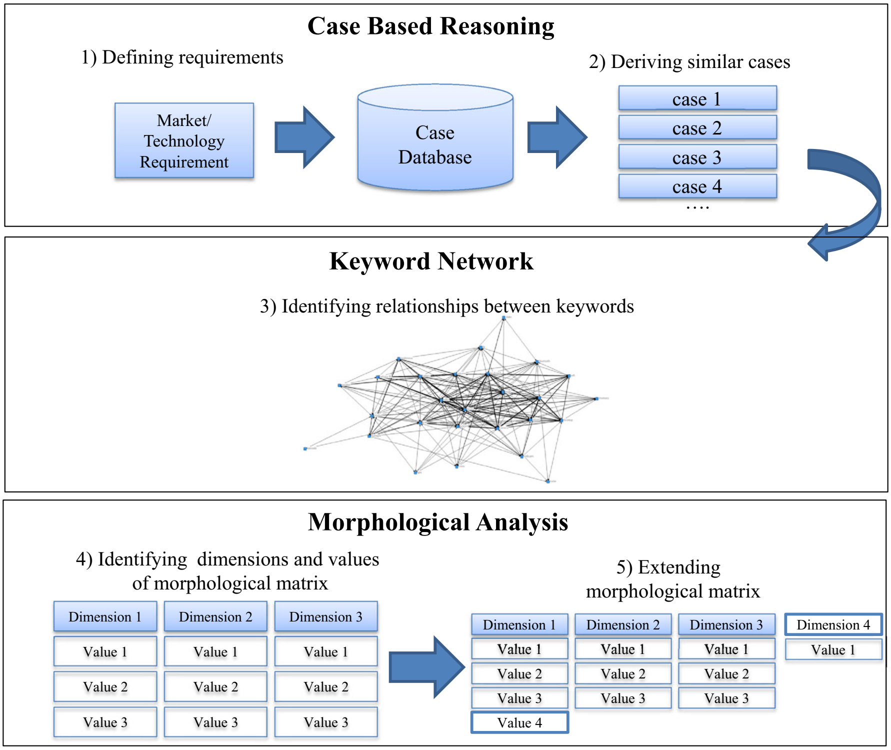


**Fig. 1** Overall process

These can be represented as problems or customer requirements. The requirements can also be for current services, since firms can develop new services based on existing ones.

### *3.2.2 Deriving similar cases*

After defining requirements, the next step is to derive similar cases by using case-based reasoning with a case database. To conduct case-based reasoning (CBR), the first step is to prepare a service database from which to find a solution (Geum et al. 2015b), and so relevant service data must be collected. For this study, we employ the database of Apple's Appstore, which is a huge collection of mobile application services. Mobile application services are representative of the recent business environment, in which many new services are generated via mobile devices and smart technology. We restructure the collected service data as a form of keyword vector that represents the contents of each service. This method is based on the concept that any document can be represented by a set of relevant keywords (Geum et al. 2015b). To provide more accurate results, we employ term frequency–inverse document frequency (TF–IDF) instead of simple term frequency. The TF–IDF is calculated by multiplying term frequency and inverse document frequency, which is represented as a logarithmically scaled fraction of the documents that contain the word in question, as shown below:

$$\mathrm{w}_{t,d} = \mathrm{tf}_{t,d} \times \log\left(\frac{N}{\mathrm{df}_t}\right),$$

where $\mathrm{tf}_{t,d}$ represents the frequency of term $t$ in document $d$, $N$ represents the total number of documents, and $\mathrm{df}_t$ represents the number of documents that contain term $t$.

Based on this calculation, the collected service documents are restructured as a form of keyword vector as follows. We used Python 2.7.9 to collect and restructure the service database, and employed the scikit-learn package of Python to derive the TF–IDF score for each keyword.

$$S_i = \begin{bmatrix} W_{11} & W_{12} & \ldots & \ldots & W_{1m-1} & W_{1m} \\ W_{21} & W_{22} & \ldots & \ldots & W_{2m-1} & W_{2m} \\ W_{31} & W_{23} & \ldots & \ldots & W_{3m-1} & W_{3m} \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots \\ W_{n1} & W_{n2} & \ldots & \ldots & W_{nm-1} & W_{mn} \end{bmatrix},$$

where $n$ represents number of documents and $m$ represents number of keywords used to explain the service document

After calculating the TF–IDF score for each keyword, we calculated document similarity based on similarity measures (i.e., similarity between these services and the target service or customer requirements). In this study, we employ the cosine similarity metric. The equation below shows how it has been employed to compare the target service and possible alternatives. Using this calculation, similar services can be derived.

$$Cos(\mathrm{D}_A, \mathrm{D}_B) = \frac{\mathrm{D}_A \times \mathrm{D}_B}{|\mathrm{D}_A| \times |\mathrm{D}_B|},$$

where $\mathrm{D}_A$ is the keyword vector of the target service (or requirements), and $\mathrm{D}_B$ is the keyword vector of the keyword in an alternative service.

### *3.2.3 Identifying relationships between keywords*

When similar services are found, we can gain important keywords from them. For similar documents, we again generate the keyword vector composed of the TF–IDF score, and conduct a network analysis for the resulting keywords. The use of network analysis is helpful for analyzing the relationships between specific keywords for the derived similar services.

After identifying the relationships between keywords, we analyze several groups that keywords are closely located within. Based on these, we can identify relevant keyword groups that are important for characterizing particular services.

### *3.2.4 Identifying dimensions and values of morphological matrix*

The identified keyword groups can be employed as important clues for constructing a morphological matrix. These groups can represent the basic characteristics of certain services, and so can be employed as dimensions of a morphological matrix. Similarly, each keyword can be employed to derive values for each dimension.

### *3.2.5 Extending morphological matrix*

When the basic structure of a morphological matrix has been developed, we can extend the matrix based on the purpose of analysis, target service, and firms' internal decisions. This work can be supported by experts, who can provide more valuable and plentiful information for new service development.

# 4 Case study

## 4.1 Case overview

Since the mobile application services currently provide a wide range of technology-based services (Kim et al. 2014), we conducted this case study using mobile application services. The mobile application service has been considered to be an important and emerging research area (Wang et al. 2014). The case study described in this paper involved *Clash of Clans*, a game service provided through Apple's Appstore platform.

Since it was released in June 2012, many customers have downloaded and enjoyed this game. Players construct and develop villages and train their militaries. The key process in the service is protecting one's village from other players around the world and widening one's territory. The core keywords representing the service include village construction, village development, military training, PvP (player vs. player) battle, and PvP alliance. It is assumed that the Clash of Clans is scheduled for an upgrade, which will add new and creative features. As such, we first engaged in case-based reasoning to identify similar previous cases, and to derive information on keyword and service networks. Based on the evidence from our network analysis, we employed morphological analysis to generate new services.

## 4.2 Case-based reasoning

We collected information on 23,094 application services within the "game" category, with a special focus on the "strategy" subcategory. The names and descriptions of all services were downloaded by using a Python program. The downloaded documents were then pre-processed to remove unnecessary keywords. The unnecessary keywords could be divided into two classes. The first included keywords that should generally be removed from texts, such as "a," "the," "an," and "of," which are generally called "stop words." We removed the English stop words defined in the Python natural language processing toolkit (NLTK) package. The other class included keywords that needed to be removed for this specific case study. For example, most of

Apple's downloaded services include keywords such as "iPod," "iPad," "iPhone," "iTunes," "phone", "tablet," "PC," "app", "iOS," "com," "http," and "www." For this reason, we removed these keywords from texts. After preprocessing, we also removed keywords that only occurred once. Based on the preprocessing, we created a TF–IDF matrix to represent the relationships between documents and keywords. If a keyword occurs many times in a certain text, the TF–IDF score increases, while if a keyword occurs many times in other texts as well, the TF–IDF score decreases.

After calculating the TF–IDF score for each keyword, we calculated document similarity based on cosine similarity, which compares a similar target service and possible alternatives. By using this calculation, we derived the top 10 similar services. To provide more concrete results, we also determined the top 30 similar services. Table 1 shows the result for similar services derived through our case-based reasoning approach.

There are manifold commonalities between the derived services: the construction and development of empires or villages, action focused on PvP battles and alliances,

**Table 1** Result of case-based reasoning (top 10 services)

| No. | Service name | Cosine similarity (compared to the original service) | Date of release | Description |
|---|---|---|---|---|
| 1 | Lost Empire Elite Edition | 0.8823 | Apr-2014 | MMO (massively multiplayer online) game, developing an empire and military (elite edition) |
| 2 | Lost Empire | 0.8810 | Apr-2014 | MMO game, developing an empire and military |
| 3 | Dragon Crown | 0.8784 | Jun-2013 | Strategy game set in Middle Ages, controlling an empire based on the Qwest |
| 4 | Hugo Troll Wars | 0.8756 | Nov-2013 | Battle strategy game, constructing and developing villages, battles, and alliances with players |
| 5 | Land of Battles | 0.8749 | Mar-2014 | Constructing and developing villages, upgrading buildings, military training, PvP games |
| 6 | Empire Four Kingdoms Medieval MMO | 0.8748 | Jan-2013 | Battle strategy game, constructing and developing villages, battles, and alliances with players |
| 7 | Arcane Battlegrounds | 0.8698 | Jun-2014 | Battle strategy game, constructing and developing villages, battles, and alliances with players |
| 8 | King's Empire Battlecalc | 0.8670 | Feb-2014 | Computing the possibilities for winning a game (supporting service) |
| 9 | Age of Kingdom | 0.8610 | Jul-2013 | Narrative simulation game, battle with other players, developing a military |
| 10 | Kingdoms of Camelot Battle for the North | 0.8609 | Nov-2011 | Strategy game set in Middle Ages |

and military training action. However, these services also have different features, such as single-play support, resource management, and the existence of heroes. Most of these services are quite similar to the original service, with slight differences. Most are MMO games that involve developing an empire and military. Some are strategy games in which different strategies are applied and their effects are simulated. One notable service is King's Empire Battlecalc, as it is quite different from other similar services. This service calculates the possibilities of winning a game based on a number of factors.

The results of case-based reasoning can be utilized for new service development in two ways. The first is to directly employ them to create new service ideas. For example, calculating the possibilities of winning a game as compared to other players could be considered a new function or service (service No. 8), and therefore firms could consider providing this service. Such ideas can also be further extended. For example, a service could be created that calculates the possibilities of succeeding in a specific action, such as battle, military development, village construction, or harvesting.

A second way to utilize case-based reasoning is as a source of indirect suggestions. In this approach, other analysis techniques, such as network analysis, can be employed to investigate the general structures of similar services, and this can enable firms to understand how similar services are composed. The results of network analysis can then be effectively employed to develop a morphological analysis that provides clues for developing certain dimensions and values.

## 4.3 Keyword network

The 10 services selected for this study were analyzed through a network analysis. Figure 2 shows the result of that network analysis, based on keyword similarity with a cut-off of 0.85. The node represents the keywords, while the edge represents the level of relationship. The degree of relationship is reflected by the node's thickness.

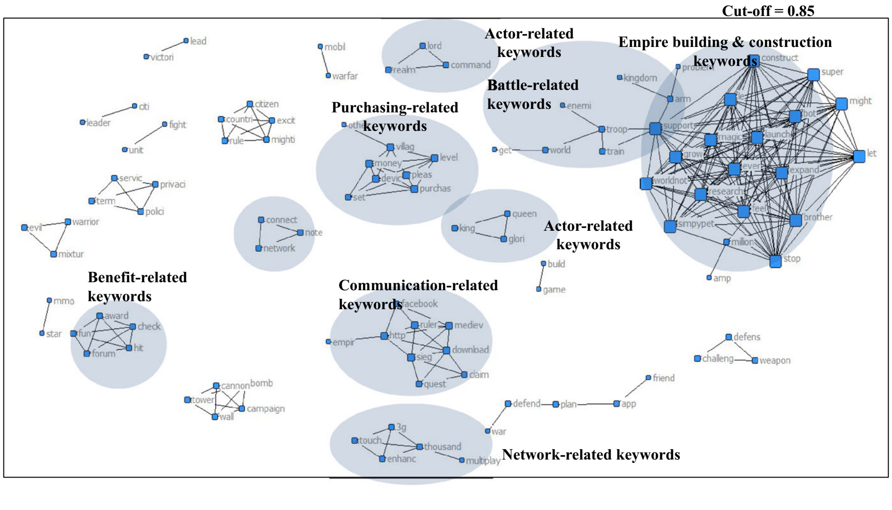


Fig. 2 The result of keyword network in the top 10 similar services

**Table 2** Keyword groups derived through network analysis

| Types | Keyword groups | Description |
|---|---|---|
| Content-related | Empire construction | Keywords related to empire building |
| | Battle performance | Keywords related to tools and techniques for increasing battle performance |
| Service-related | Purchasing | Keywords related to in-app purchases and payments |
| | Communication | Keywords related to SNS posting and in-game communication |
| | Benefits | Keywords related to game benefits (such as awards, fun, etc.) |
| Technology-related | Networks | Keywords related to networks and connections |

In investigating our results, we clustered several groups based on their similarity measures. The dominant groups included content-related keywords, service-related keywords, and technology-related keywords, as presented in Table 2.

### 4.4 Morphological analysis

Based on the keyword network and the keyword groups identified from the keyword network, we developed a morphological matrix. Since the keyword network is based on overall service description keywords, it is rare for each document to contain all of the keywords for a certain service. As such, the participation of experts is critical to determining the final structure of a morphological matrix. For this study, we employed three experts who had at least 5 years of practical experience in content development for game services. Since our network analysis results showed two different types of development of new services—content creation and service provision—we prepared two different morphological matrixes, from the content and service perspectives. Whenever dimensions were hard to assess based on the network analysis results, we referred to expert judgment and a literature review. For example, our genre dimension was prepared based on the work of Lee et al. (2009). Also, we ignored the network-related aspects in the results of our network analysis, since these were too technical for involvement in the development of new services.

**Table 3** Morphological matrix for the content perspective

| Objects | Activities | Actors | Budget |
|---|---|---|---|
| [O1]Land | [A1]Development | [T1]Royal Family | [B1]Money |
| [O2]Infrastructure | [A2]Extension | [T2]Commoners | [B2]People |
| [O3]Buildings | [A3]Construction | [T3]Merchants | [B3]Tools and equipment |
| [O4]Farms | [A4]Reproduction | [T4] Peasants | [B4]Animals |
| [O5]Animals | [A5]Helping | [T5] Soldiers | [B5]Weaponry |
| [O6]People | [A6]Communicating | | |

**Table 4** Morphological matrix for the service provision perspective

| Genre | Benefit | Purchase | Communication |
|---|---|---|---|
| [G1]RPG (role-playing game) | [B1]Award/Ranking | [P1]Avatars | [S1]Share |
| [G2]Simulation | [B2] Money | [P2]Infrastructure | [S2]Invite |
| [G3]PvP | [B3] Fun | [P3]Tools and equipment | [S3]Post |
| [G4]Puzzle | [B4]Killing time | [P4]Accessories | [S4]Ask for aid |
| [G5]Adventure | [B5] Social relations | [P5]None | [S5]Ask for purchase |
| | | | [S6]Compete |
| | | | [S7]Play |

**Table 5** New service concepts from the content perspective

| Combination | New service or function alternatives |
|---|---|
| O1-A2-T5-B5 | Soldiers battle and engage in combat to increase their land |
| O3-A3-T2-B3 | Players construct new buildings and infrastructure to provide benefits for an empire |
| O4-A1-T2-B3 | Farmers increase and develop their farms by feeding animals and harvesting grain and corn |
| O6-A1-T1-B2 | Players raise their children from birth to adulthood. Common people raise their own children, while others are involved in raising the children of the royal family |
| O6-A2-T1-B2 | Players manage their human capital by hiring or paying individuals |
| O5-A1-T2-B2 | Players raise and sell their animals |
| O1-A5-T2-B3 | Players help others work and send requests for help with their work |
| O6-A6-T2-B2 | Players communicate with one another (greetings, activities, gifts) |

**Table 6** New service concepts for the service provision perspective

| Combination | New service alternatives |
|---|---|
| G1-B5-P1/P3-S5 | Players ask friends to purchase tools and avatars |
| G1-B5-Pu3-S4 | Players help others with work that requires specific tools |
| G4-B1-P5-S3 | Players post their performances to an SNS |
| G4-B4-P5-S7 | Players play other genre games to spend their time during plant or animal growth |
| G3-B2-P5-S6: | Players earn money or grants through competition |

We developed two different types of morphological matrixes, one from the content perspective and one from the service perspective. The content perspective represents how new content is generated, as shown in Table 3. The service perspective represents how new services can be provided to aid customers, as shown in Table 4.

Based on this morphological matrix, we can generate several combinations for new service alternatives, as shown in Tables 5 and 6.

## 5 Conclusion

This paper suggests a means of generating new smart service ideas by combining case-based reasoning and morphological analysis. To effectively engage in morphological analysis, similar service cases are identified through case-based reasoning, and their structures are explored through network analysis. The results are then used to identify relevant dimensions and values for morphological analysis, which is critical to the success of new service generation. This combination of case-based reasoning and morphological analysis can provide integrated links for effective idea generation. The use of case-based reasoning can provide a set of similar services that are already provided to the customers. The results are then used as inputs to build the morphological matrix, which addresses the limitation of previous research in which morphological matrices are developed in an expert-based qualitative manner. Therefore, the use of integrative approach can help generate new service innovation.

The suggested method—a case-based morphological matrix—can resolve the problem of subjective building of morphological matrix. Currently, the task of identifying values and dimensions is subject to expert judgment, with the lack of scientific or systematic way. Therefore, providing similar previous services and their relationship structure might be very helpful to build the morphological matrix.

Based on the assumption that new service ideas can be generated based on the reuse and combination of existing services, the integrative use of case-based reasoning and network analysis can significantly increases the efficiency and effectiveness of morphological analysis.

Despite making some significant contributions to existing research, this paper still includes some limitations. First, even if we take an integrative approach to new service generation, the methods for applying the results of the network analysis to morphological analysis still involve subjective judgment. Even if keyword patterns represent how a service is composed, the results need to be investigated by domain experts and systematically transformed for morphology analysis. Therefore, future studies should explore how to reflect the results of network analysis to the morphological matrix building, with little expert participation. To conduct this, the use of network indicators such as centrality measures can be employed. Second, we conducted a case study for one domain: smartphone application services, especially the game service. To provide more meaningful implication, the case study could be extended to several other domains in the future. By extending the case study to the multiple domains, more general guidelines can be provided for building morphological matrixes or linking the results of network analysis to morphological matrixes, based on the consideration of different types of services.

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## References

Aamodt A, Plaza E (1994) Case-based reasoning: foundational issues, methodological variations, and system approaches. AI Comm 7:39–59

Ahmed-Kristensen S, Vianello G (2015) A model for reusing service knowledge based on an empirical case. Res Eng Des 26:57–76
Allmendinger G, Lombreglia R (2005) Four strategies for the age of smart services. Harv Bus Rev 83:131–145
Barrett M, Davidson E, Prabhu J, Vargo SL (2015) Service innovation in the digital age: key contributions and future directions. MIS Quart 39:135–154
Basole RC, Karla J (2012) Value transformation in the mobile service ecosystem: a study of app store emergence and growth. Serv Sci 4:24–41
Chai K, Zhang J, Tan K (2005) A TRIZ-based method for new service design. J Serv Res 8:48–66
Cheng CC, Tsai MC, Lin SP (2015) Developing strategies for improving the service quality of casual-dining restaurants: new insights from integrating IPGA and QFD analysis. Total Qual Manag Bus Excel 26:415–429
Cho IJ, Kim YJ, Kwak C (2015) Application of SERVQUAL and fuzzy quality function deployment to service improvement in service centres of electronics companies. Total Qual Manag Bus Excel. doi:10.1080/14783363.2014.997111
Dong A, Lovallo D, Mounarath R (2015) The effect of abductive reasoning on concept selection decisions. Des Stud 37:37–58
Edvardsson B, Olsson J (1996) Key concepts for new service development. Serv Indust J 16:140–164
Gallouj F, Weinstein O (1997) Innovation in services. Res Policy 26:537–556
Geum Y, Lee S, Kang D, Park Y (2011a) The customisation framework for roadmapping product-service integration. Serv Bus 5:213–236
Geum Y, Kim S, Park Y (2011b) Development of new mobile application services: An approach using context-driven morphology analysis. Proceeding of the 8th international conference on service systems and service management (ICSSSM), pp 1–6
Geum Y, Jeon H, Lee H (2015a) Developing new smart services using integrated morphological analysis: integration of the market-pull and technology-push approach. Serv Bus. doi:10.1007/s11628-015-0281-2
Geum Y, Noh E, Park Y (2015b) Generating new service ideas: the use of hybrid innovation tools to reflect functional heterogeneity of services. R Manag. doi:10.1111/radm.12118
Gustafsson A, Kristensson P, Witell L (2012) Customer co-creation in service innovation: a matter of communication? J Serv Manag 23:311–327
Halloran L (2012) Value drivers for smart service technology. Doctoral dissertations, Ryerson University, Toronto
Hyde KF (2000) Recognising deductive processes in qualitative research. Qual Market Res Int J 3:82–89
Kandampully J (2002) Innovation as the core competency of a service organisation: the role of technology, knowledge and networks. Eur J Innovat Manag 5:18–26
Kim C, Choe S, Choi C, Park Y (2008) A systematic approach to new mobile service creation. Expert Syst Appl 35:762–771
Kim J, Park Y, Kim C, Lee H (2014) Mobile application service networks: apple's App Store. Serv Bus 8:1–27
Kovács G, Spens KM (2005) Abductive reasoning in logistics research. Int J Phys Distrib Logist Manag 35:132–144
Krumholz HM (2014) Big data and new knowledge in medicine: the thinking, training, and tools needed for a learning health system. Health Aff 33:1163–1170
LaValle S, Lesser E, Shockley R, Hopkins MS, Kruschwitz N (2011) Big data, analytics and the path from insights to value. MIT Sloan Manag Rev 52:21–34
Lee C, Lee H (2015) Novelty-focussed document mapping to identify new service opportunities. Serv Indust J 35:345–361
Lee C, Song B, Park Y (2009) Generation of new service concepts: a morphology analysis and genetic algorithm approach. Expert Syst Appl 36:12454–12460
Matthing J, Kristensson P, Gustafsson A, Parasuraman A (2006) Developing successful technology-based services: the issue of identifying and involving innovative users. J Serv Market 20:288–297
Nagata A, Kobayashi T, Hasegawa K, Moroga K, Kuriyama Y, Ohno T (2014) Development of the case-based reasoning system for regional science and technology policy: an interim report. In. Proceeding of the management of engineering & technology (PICMET), pp 135–139
Ölvander J, Lundén B, Gavel H (2009) A computerized optimization framework for the morphological matrix applied to aircraft conceptual design. Comput Aided Des 41:187–196

Recio-García JA, González-Calero PA, Díaz-Agudo B (2014) jcolibri2: a framework for building case-based reasoning systems. Sci Comput Program 79:126–145

Son C, Geum Y, Park Y (2013) How to identify the trends of services: gTM-TT service map. Expert Syst Appl 40:2956–2965

Spohrer J, Maglio PP (2010) Toward a science of service systems: value and symbols. In: Maglio PP, Kieliszewski JA, Spohrer JC (eds) handbook of service science. Springer, New York, pp 157–194

Stroulia E (2010) Smart services across the real and virtual worlds. In: Chignell M, Cordy J, Ng J, Yesha Y (eds) The smart internet. Springer, Berlin, pp 178–196

van der Aa W, Elfring T (2002) Realizing innovation in services. Scand J Manag 18:155–171

Wang J, Lai JY, Hsiao LC (2014) Value network analysis for complex service systems: a case study on Taiwan's mobile application services. Serv Bus. doi:10.1007/s11628-014-0237-y

Weber RG, Condoor SS (1998) Conceptual design using a synergistically compatible morphological matrix. In 28th annual conference on frontiers in education, IEEE, Tempe

Wu MC, Lo YF, Hsu SH (2006) A case-based reasoning approach to generating new product ideas. Int J Adv Manuf Tech 30:166–173

Wu MC, Lo YF, Hsu SH (2008) A fuzzy CBR technique for generating product ideas. Expert Syst Appl 34:530–540

Yoon B, Park Y (2005) A systematic approach for identifying technology opportunities: keyword-based morphology analysis. Technol Forecast Soc Change 72:145–160

Yoon B, Park I, Coh BY (2014) Exploring technological opportunities by linking technology and products: application of morphology analysis and text mining. Technol Forecast Soc Change 86:287–303

Yu EJ, Kwak C (2015) Service development using fuzzy QFD in the banking industry. J Korean Soc Qual Manag 43:103–124

Zhang H, Chai K, Tan K (2005) Applying TRIZ to service conceptual design: an exploratory study. Creat Innov Manag 14:34–42