The Evolutionary Process from a Technology Concept to a Service Concept: A Cloud Computing Case Study

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***Abstract*--In Information Technology (IT) , new concept words frequently appear and affect the business environment. In several cases, the core technologies and architectures remain the same despite slight concept changes. For example, both grid computing and software as a service (SaaS) are considered to be the forerunner of cloud computing.**

In this paper, we describe the manner in which we applied a text mining approach to analyze all articles of the 2002—2012 editions of a famous IT magazine; attributing to this analysis, we propose a new evolutionary model describing how technological concepts are transformed into services. We focus our analysis on cloud computing, and this analysis reveals that the technical concept of "grid computing" and other related concepts appeared together in the first phase. In the second phase, such a group of words integrate to form a new concept－SaaS, which later expands into PaaS and IaaS. Finally SaaS develops into "cloud computing," and gains recognition in each industry as a completely specialized service concept (i.e., "x-cloud") .

In addition, our analysis reveals that concept evolution has been affected by another evolution, namely from the organization-oriented world to the individual-oriented world by the advancement of social networking in our societies. This phenomenon provides further interpretation on concept evolution.

I. INTRODUCTION

"Cloud" originated as an IT term, but quickly gained recognition in other fields. Cloud serves as an abbreviation for cloud computing and is conceptually a computer network configuration and a source of resource utilization that offers information or application services via computing resources to users.

However, cloud is not a new concept. In the IT industry, the base of cloud was grid computing technology. Later, passing through several concepts, grid computing reached the current term―cloud computing. Over the time, there have been some transitions of the business model view, but the vision, architecture, and basic technologies underlying the concepts remain the same.

According to the definition of cloud computing by the United States National Institute of Standards and Technology (NIST) , one of the service models of cloud includes software as a service (SaaS) . Therefore, cloud computing may be considered as a mere rephrasing of SaaS and that the concept itself existed in the past.

However, SaaS and cloud do not appear at the same timing. Cloud needed some more years after SaaS had appeared in the IT industry. For example, business exhibitions are very common in the IT industry, and several comprehensive events are held every year. In 2008, green IT, SaaS, virtualization technology, and next generation network were key IT topics. Between 2009—2010, cloud computing became the main topic that was then followed by the new key phrase "big data" in 2012. Since then, big data has highly influenced technology, and articles about big data have been frequently published in newspapers, magazines, and across the Internet. From the advertisement industry's perspective, business reasons take precedence over technical reasons or meanings. A term such as "signboard" requires gathering more attention. In case of a business exhibit, accumulating sponsoring companies for the exhibition is a top priority. In addition, technical terminology and service terminology appear in IT-related magazines or headlines of newspapers. After staying for months or years, they disappear without notice.

In our research, we focus on the following questions. Why is a signboard selected at a given time? Why is it replaced shortly thereafter? How does the concept of a cloud differ from the concept of grid computing and SaaS? What has been inherited and developed from grid computing and SaaS to help from cloud computing? By verifying and systematizing the process leading to cloud computing, does the pattern of concepts development become clearer?

The purpose of our research is to identify the evolution of a concept from a technology to a service by observing IT keywords' transition for the case study of cloud computing; further, we consider the results of this investigation from the knowledge science viewpoint. In other words, a pattern of IT keywords' evolution can be detected by analyzing and organizing the evolutionary process from grid to cloud computing. After collecting and generalizing these patterns, formulating a method to measure the possibility of new concepts by observing their evolving patterns will be expected in the future. Moreover, we can evaluate whether a newly appeared concept will be further developed or will disappear without any further evolution.

We approached out research via a cloud computing case study. Though the background and structure of our case study are described later in our research, we applied text mining techniques to articles from a popular biweekly IT magazine in Japan. IT keywords from all articles covering over a decade were analyzed by our text mining application. In the case of the IT industry, almost all concepts came from the United States. Further, we interviewed three experts in the IT industry asking each of them to consider our analysis results and provide additional knowledge and comments from their expertise. There expects were as follows.

(1) Mr. N. Yashima: Former chief editor of the IT Magazine "Nikkei Computer" by Nikkei BP Publishing Company,
(2) Mr. M. Iseri: CEO of the IT media company "Impress

R&D",

(3) Ms. S. Takeo: Executive system engineer of a global IT company.

The purpose of our research was not to study the technical growth of concepts instead our aim was to identify the trends of a concept by tracking the transition of keywords. Later in this paper, we present our analysis results from text mining; further, we discuss our results from the knowledge management point of view. Moreover, additional knowledge and considerations from our interviewees have been inserted into the discussion.

II. BACKGROUND

A. Literature Review

In this section, we review previous work in related fields. The preferential literature focused on terminology trends can be classified into the following research categories: (1) relationships between concepts; (2) technology intelligence regarding techniques to offer new value via concepts; (3) the theory of keyword trends from the management consultant viewpoint; and (4) analytical methodologies regarding concept changes.

First, we focus on previous work concerning the relationship between concepts. According to Villegas [21], the base of cloud computing is grid computing. Foster [4] compared both cloud and grid computing from multiple directions and concluded that cloud is not a new concept rather it is a result derived from the theory of grid computing and the relationship with previous technologies. Though these concepts include several different points of business model and security, the vision, architecture, and basic technologies are common. Youseff [20] reported that cloud evolved by converting multiple technologies, such as grid computing, service oriented architecture (SOA) , and virtualization, and then subdivided cloud computing into five layers to discuss the meaning of its existence.

As noted in the abovementioned section, SaaS was included as one of three service models of the cloud computing definition of NIST. Owing to this, cloud computing is generally understood as a paraphrase of SaaS that existed in the past. As Misaki [9] described "some people say that cloud is just a same as SaaS, and nothing is really changed. Then the essence of cloud is inquired".

In our research, we will systematically clarify the difference between cloud and grid computing as well as SaaS, what is inherited, and the manner in which cloud computing developed.

Technology intelligence encompasses the knowledge that describes how to acquire all available information to support technology and manage decision-making. Sugasawa [13] expressed "customer feels a value of products or services when they find some difference". According to Poster [12], an enterprise can hold down a rival only when it is able to bring a possible value that is constantly different to the customer in the long term. According to La [8], a service is something that can be easily utilized and relied on by solving a problem and risks originally via technology.

In summary, discriminating the competitor to guarantee competitive predominance is important; thus, the competitor must be rich in creativity. As a strategy, using a new concept we propose a technique used by the enterprise to ensure conversion; however, whether or not the concept becomes fixed depends on society.

Therefore, we note that the manner in which a new concept is born, selected, and evolved is meaningful.

Some research has focused on the trends of terminology from the management consultant point of view. Giroux [5] expressed that from this point of view, labeling a concept is not based on mere interest, but on the change and the progressive element of the society. Alvesson [1] noted that knowledge management can be sorted and classified by the type of concept because knowledge and management are considered as a combined concept. Until then, knowledge and management had been recognized as two different concepts. Both Girouz [1] and Alvesson [5] discussed and investigated the meaning of one concept from multiple directions.

Conversely, some literature has discussed the theme of concept transition. Arino [2] analyzed the titles of research announcements of the World Wide Web (WWW) academic society over approximately ten years and demonstrated the relative characteristics, and suggested a technique useful for decision-making strategies in research and development (R&D) . Furthermore, Tsumoto [15] insisted that a new concept appears every year, but only a few remain, depending on the number of times the concept was adopted in documents released to society. Tsumoto [15] analyzed technology trends based on the appearance frequency of technical terms in medical care research dissertations. Tseng [14] studied patent application documents and detected several important results via text mining. Because patent application documents comprise structured information, it can be configured using a selection rule. The data can be collected automatically using such selection rules, though until recently, this was a slow and manual operation. By studying the emerging patterns and connections between patents, the criticality or degree of influence can be grasped for each patent. In addition, Yoon [19] presented a method to construct a network of patents by mining patent application documents.

The literature cited above is a methodology research that describes how to fit application software of text mining into the structure of patent application documents and fetch information. This approach is not applicable to unstructured data.

B. Definition of terms

In this section, we define each concept based on the literature and sort them by commodity. As a basic prerequisite for our research, we describe the history and technical features of cloud computing, SaaS, and grid computing.

Though the explanations are brief, they should be sufficient because the purpose of our research is to detect and analyze the change of a concept through keywords in the aforementioned magazine over a decade.

Cloud computing (2006~)

Eric Emerson Schmidt, former CEO of Google, used the term "cloud computing" in the keynote presentation at a search engine strategic meeting in August 2006, which was reportedly the first time this phrase was used in public. Cloud is a generic name of the technologies and services implemented via flexible information processing through the Internet. Users can purchase and utilize applications, basic software, and hardware as services without being conscious of individual resources or location on the Internet. Cloud is an abbreviation of cloud computing.

SaaS (1999~)

Marc Benioff, a former executive of Oracle Corporation, established Salesforce.com, Inc. on March 8, 1999 and suggested the concept of SaaS. He introduced the new method to provide software functions of Customer Relationship Management (CRM) systems as services via a network. Until that time, CRMs had been sold as comprehensive packages for which users paid large amounts of money. In 2006, cloud computing evolved and reached the point at which the software offered on cloud was called SaaS.

Grid computing (90s~)

The term "grid" originates from the electrical power grid (i.e., the electrical transmission network) . As a user of electricity, being conscious of which power plant created the electricity is not necessary; the processing of a computer can be thought of in the same way. It is a mechanism in which several computing resources (e.g., CPU, information storage area, hard disk capacity, etc.) on a wide area network are connected and together form a computer system that offers computing services. This technology was developed to store huge volumes of data or perform large-scale computing transaction on a network of machines rather than buying an expensive supercomputer.

Concepts and keywords

The definition of the term "concept" is the generalized meaning of a phenomenon that comprehends, abstracts, and generalizes common items of a certain matter, and contributes to categorize, identify, and classify actual events and relations between such matters. In this paper, a keyword is the naming of a concept.

Technology and service concepts

A "technology concept" is the concept of expediently handling or processing of some things technically. A "service concept" is the concept of behavior that an intangible commodity offers; the concept of a non-physical commodity that supplies and consumes at the same time.

III. EVOLUTION OF A CONCEPT

In this section, we introduce the methodology of analysis and then execute the analysis via text mining according to the method. Some evolutionary patterns of concepts were detected via the analysis results; therefore, we also propose a model in this section. Before starting such analyses, we begin by explaining the transition of a concept by sorting commodities.

A. The transition of a concept by sorting commodities

Yamamoto [17] arranged commodity sorting by including intangible commodities, via the following two axes: (1) the source that generates use; and (2) move the proprietary of the source that generates use. As illustrated in Figure 3.1, by sorting the commodity of grid computing, SaaS and cloud computing, we verify that the meaning of a phenomenon changes from a tangible commodity and information produced by technology to where service is an entity. In other words, it is understood that the character of concept has moved from being technology-related to service-related.

Yamamoto (2010) Sort of commodity

	The source which generates use is the physical commodity	The source which generates use is the non-physical commodity
There is moving the proprietary	Tangible commodity	Information
There is NO moving the proprietary	Utilization right of tangible commodity	Service

Sort of commodity		Example	Grid Computing	SaaS	Cloud Computing
The source which generates use is the physical commodity	There is moving the proprietary	Tangible commodity	Server, Storage, etc.	None	None
	There is NO moving the proprietary	Utilization right of tangible commodity	None	Utilization right of Disc space (Monthly rate)	None
The source which generates use is the non-physical commodity	There is moving the proprietary	Information	Application SW	None	None
	There is NO moving the proprietary	Service	None	Utilization right of application SW (Monthly rating)	Utilization right of computing (One minute unit rating)

Figure 3.1: Sort of commodity of computing
(Yamamoto [17] p.44 and Hayashi [6] p.12)

B. Methodology

The design technique of this case study follows Ishimatsu [7] and is based on the technique of Yin [18]. According to Eisenhardt [3], the process involves case selection, a comparison with existing literature, data acquisition, data analysis, model generation, and summary of heuristic item. Text mining was adopted as the analytical method; the target text data are the articles of "Nikkei Computer", the most popular biweekly IT magazine published by Nikkei Business Publications, Inc. This publication as in [11] is a comprehensive IT information magazine that offers detailed descriptions, columns, and content regarding the use of two-way communications in networks.

All articles published post 2002 are available on the home page of the magazine, and searching and downloading all such content is possible. For our research, articles from January 2002 to December 2012 were gathered as object data. We collected 22,000 articles, which is a sufficient amount for text mining.

Based on the structure of each story—i.e., each story was well-summarized in the first two paragraphs—we deemed it acceptable to interpret the entire contents of each article via the first two paragraphs. In this research, therefore, only this summary portion was adopted for analysis because the entire articles sometimes included other topical or biographical information toward the bottom, which could cause unnecessary (and irrelevant) confusion.

For text mining, we used IBM Content Analytics version 3.0 (ICA3.0) , released in June 2012. ICA3.0 corresponds to big data and is able to handle several hundred million cases or peta-byte class information. ICA3.0 is a software product that collects only necessary information from unstructured information, such as writings or documents on Internet; the software can consistently sort and analyze the information.

To obtain effective results from the text mining process, knowledge and techniques of the person implementing the text mining method is very crucial. Without this ability or by just freely using the text mining application to analyze big data, obtaining meaningful analysis results is not possible. To solve this problem, we used the "Nasukawa method" for analysis, introduced by Nasukawa [10], who is an ICA3.0 researcher. The Nasukawa method originated from knowledge and experiences that Nasukawa obtained in actual projects. He described his method in three steps that were designed to reach an effective result via text mining.

In step 1, the method identifies the purpose to be that "the entire image of the data is grasped". We aim to grasp the features of distribution by analyzing various output images produced by ICA3.0 (Figure 3.2.1) . In step 2, the method identifies the purpose to be that "bias and change are discovered" and executes "the contents bias," which is detected by correlation analysis, "the time wise bias," which is detected by deviation analysis, and "trend analysis," which is detected by change analysis. If something is to be observed in this phase, further enhancements to the object data are required to grasp clear features. In step 3, "an application scenario" is investigated concerning the data features identified in step 2, and a story using the big data is detected.

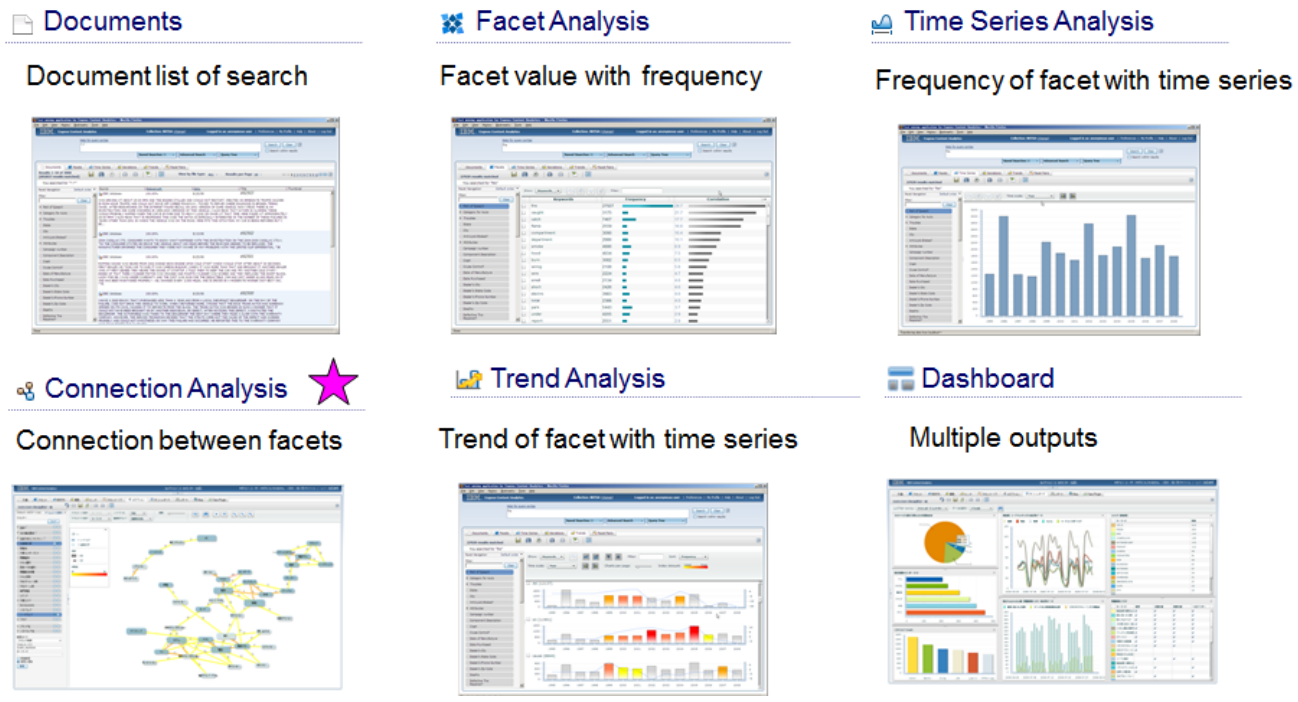

Figure 3.2.1: Output image of ICA3.0

Following the Nasukawa method in steps 1 and 2, the connection analysis output images exhibits relative characteristics of keywords, as illustrated in the bottom-left image of Figure 3.2.1. Connection analysis is performed based on the correlation values that automatically measure correlations with the keywords. The correlation values have no direct relation with frequency, but reveal something about the strength of the relationships between keywords.

The correlation algorithm is as follows. First, a correlation value is defined concerning two document populations, A and B. Further, D indicates all document population, and # indicates the number of documents. The left and right-hand sides become the same.

$$\frac{\#(A \cap B)/\#A}{\#B/\#D} = \frac{\#(A \cap B)/\#D}{(\#A/\#D)(\#B/\#D)}$$

Example document populations include the following:

A={ "Commercial Product": The document of category keyword "PC"}

B={ "Noun…want": The document of category keyword "Manual…acquire…want"}

Given these example A and B values, the left-hand side of the above equation is as follows:

$$\frac{\text{The ratio of "Need the manual about PC"}}{\text{The ratio of "Need the manual"}}$$

If 5% of people need the manual in all documents and 20% of people need the PC manual in all PC documents, the correlation value between "PC" and "Manual…acquire…want" is high (Figure 3.2.2) .

The description above shows the logic involved in this system, but with ICA3.0, interval estimation is performed depending on the reliability of the data. By using this correlation between each keyword of concept within the time series, a map is described, as illustrated in Figure 3.3. The elliptical size of each keyword corresponds to frequency. A value of 1.0 indicates an even correlation, whereas a value greater than 1.0 indicates a strong correlation, and a value less than 1.0 indicates a weak or no correlation. The change for a given keyword can be observed by following the keyword that has stronger correlation in the time series.

1.0 > Correlation value : Correlation is weak
1.0 = Correlation value : Average
Correlation value ＞1.0 : Correlation is strong

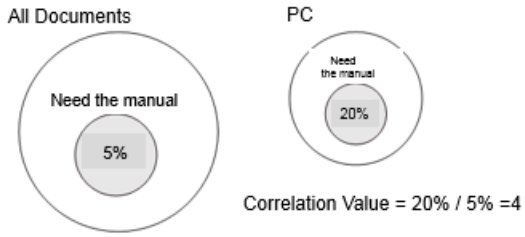

Figure 3.2.2: Device of ICA3.0 correlation value

Connection analysis is one of the output forms of ICA3.0 based on the above theory, thus summarizing the analytical method of our research.

C. Analysis results

In this section, we describe the analysis results of our case study. The structure of all text data crawled (i.e., collected) by text mining was analyzed. Text mining is a tool used to select some keywords from the results of structure analysis and discover some relative characteristic from them. Though there is a means to setting keywords automatically entirely from text data, general business terminology, such as "department manager" or "meeting," may appear as keywords. In such cases, one more step is required to select keywords

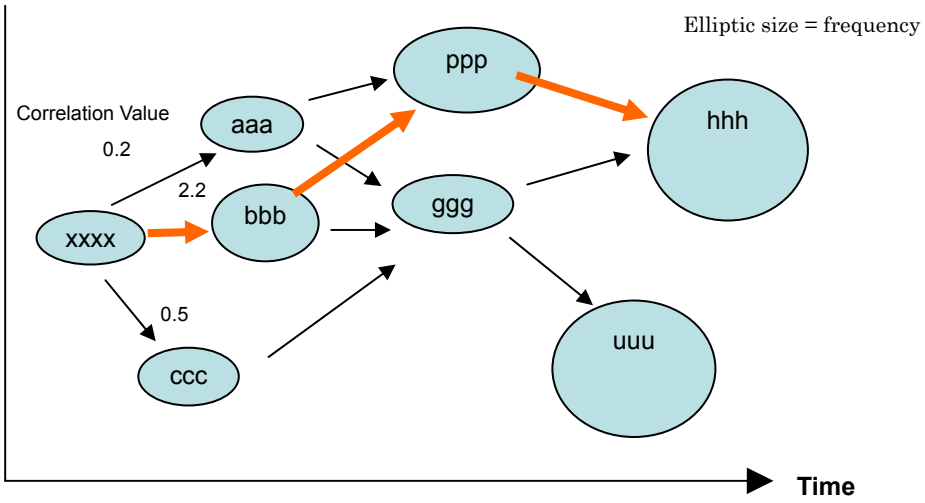

Figure 3.3: ICA3.0 connection analysis (example output image)

that can be used for IT concept transition. Therefore, in this case study, we decided to set keywords manually; note that ICA3.0 has a function to manually register keywords.

We focused on a page that explains a term as a "keyword" in every edition of the magazine. Based on our interview with N. Yashima, the selection criteria of a keyword on this page is as follows: (1) the necessity to succinctly explain a technical term; (2) those that should be checked as a technical trend; and (3) those that are proposed as important words at the moment. As illustrated in Figure 3.4, examples here include peer-to-peer, SOA, mashup, IP address, etc. before 2010, and social networking service (SNS) , SaaS, cloud computing, big data, etc. after 2010.

In our research, approximately 500 keywords were selected on this page from 2002 to 2012, and were manually registered into ICA3.0 as concepts to be analyzed. From the 22,000 articles, the article that corresponds to each given keyword can be selected. If there is a keyword that appears multiple times in the same article, the count remains at 1.

In step 1, the entire image demonstrates the concept of cloud computing transition via the frequency and correlation analysis as well as the deviation analysis (i.e., time-serial deviation) concerning all of the approximately 500 keywords.

In step 2, to ensure that the features of cloud case are clear, we performed connection analysis on the correlation between keywords, as shown in Figure 3.4. The x-axis along the bottom of the figure illustrates the progression of years; there is no special meaning in the y-axis position. The color of lines between two words depends on the correlation value and spans from orange to red as the correlation becomes stronger.

Reasons why the 500 keywords are not displayed in Figure 3.4 (i.e., why some keywords are not plotted) include the following: (1) the appearance frequency is extremely small, i.e., 5 or less;, (2) no correlation with other keywords exists; and (3) the keyword has a strong correlation with many others for several years, such as "virtualization"; virtualization is the basis of many technologies and services since 2006 and therefore connects with many keywords, thus making it is difficult to identify the evolution process of the word.

Figure 3.5 is a subset of Figure 3.4 that focuses only on keywords related to the cloud computing case study. The transition from grid computing to cloud computing via SaaS, and some related keywords, are together potted on the same time series. Noticing this flow, we observe technical keywords and hardware/software products that have appeared at the same time as grid computing, but when SaaS appears in 2007, PaaS and IaaS appeared following after SaaS. We therefore conclude that those keywords were connected to cloud computing and further keywords were developed after cloud computing. Those keywords having a strong correlation with cloud computing were, for example, enterprise cloud, private cloud, and public cloud. The correlation values represented in the range 2.2—4.0 are in yellow, 4.1—6.0 are in orange, 6.1—15.0 are in pink, and 15.1 and above are in red.

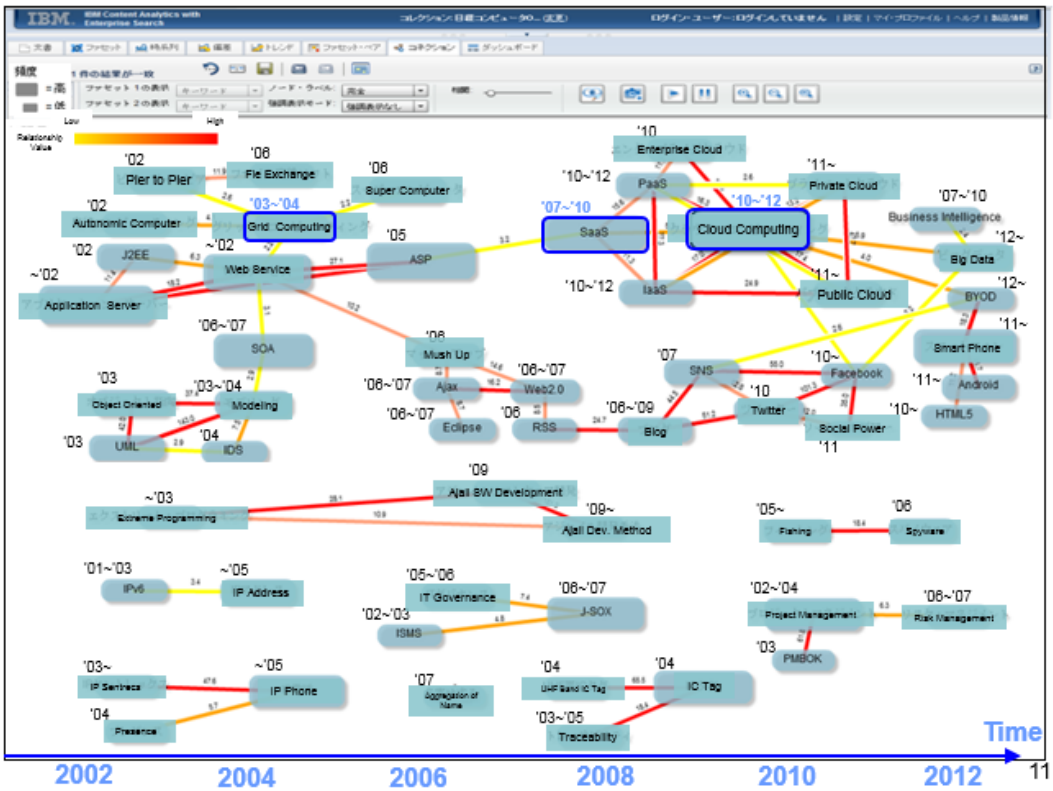

Figure3.4: Connection analysis results for data spanning from 2002 to 2012

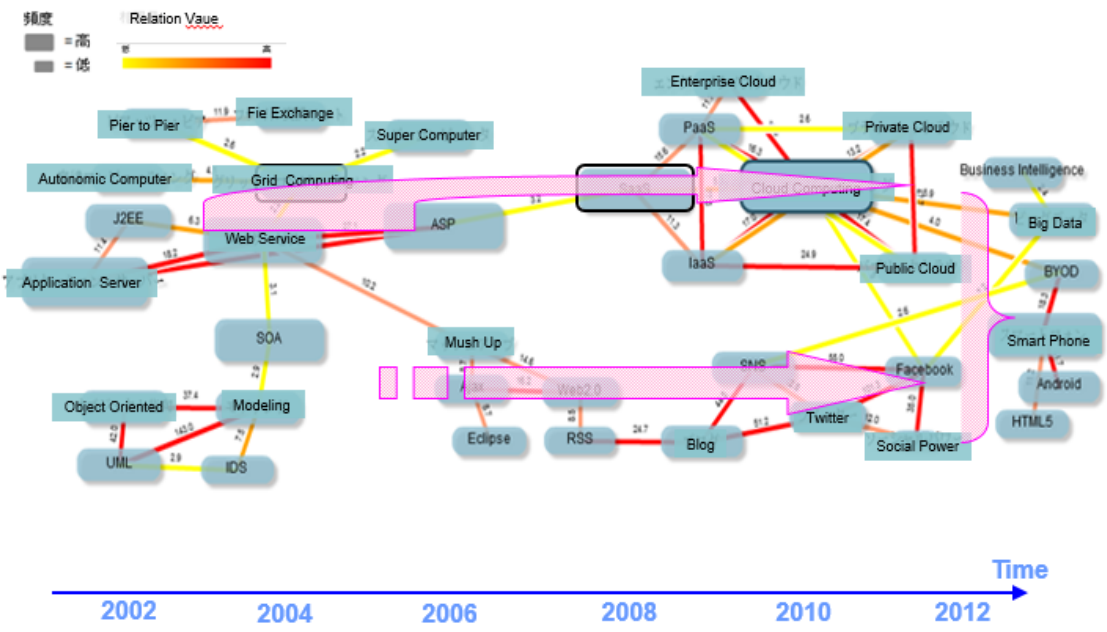

Figure 3.5: Connection analysis results focused on cloud computing spanning from 2002 to 2012

We also observed the transition of some keywords regarding social networking in the figure. Both were consistently connected to two new concepts, namely Bring Your Own Device (BYOD) and big data. The flow of social networking is considered to be output data essentially when utilization values of Twitter or blogging are discussed. It means that a mobile itself is effective as data rather than only as device. The flow of this data and the flow of the computed data that reaches from the grid to cloud have been connected together, with those two flows developing BYOD and big data in 2012. Further, BYOD and big data probably will be evolved in the following generation.

D. Modeling

Based on the obtained results, the process of concept evolution is modeled in Figure 3.6. From 2002 to 2005, grid computing had a strong connection with keywords such as web service and application service provider, which became components of a service in the next phase. This phase means the congregating phase of components for service business.

Post the trend of SaaS, the keywords PaaS and IaaS appeared in 2007. These are coined words devised in each IT server layer, application, middleware, and the infrastructure. Applying this phenomenon to the structure of IT server unit, keywords accomplished development in the vertical direction. From the interview with S. Takeo (2013) , “PaaS and IaaS that followed SaaS, probably appear inevitably for services in the IT industry.”

In 2010, SaaS developed into cloud computing, and then two smaller clouds, namely private and public clouds were created. From the given articles, the cloud terminology became specialized in various industries, including a “self-governing community cloud” for government and municipal offices, medical clouds in hospitals, and similar industries.

According to S. Takeo (2013) , “because rules and standards differ depending on industry, constructing cloud in the norm is necessary.” In general, customization occurs, but technical evolution, which we noticed in the SaaS phase, does not occur in this cloud phase. Therefore, evolution is considered in the horizontal direction and there is no technical progress.

After cloud computing gained recognition in 2010, it had already existed for five years. Without being displaced by a new word, cloud has been further subdivided into “x-cloud" subsets. In short, the overarching concept of cloud computing became fixed and fully grown.

IV. DISCUSSION

A. Considerations

Heuristic items obtained from the text mining results are collected in this chapter. One such heuristic is generalizing concept evolution from grid to SaaS and cloud as well as illustrating the model, as in Figure 4.1. Another heuristic is drawing an image with a wide field of vision, which includes changes of social networking, ad illustrated in Figure 4.3.

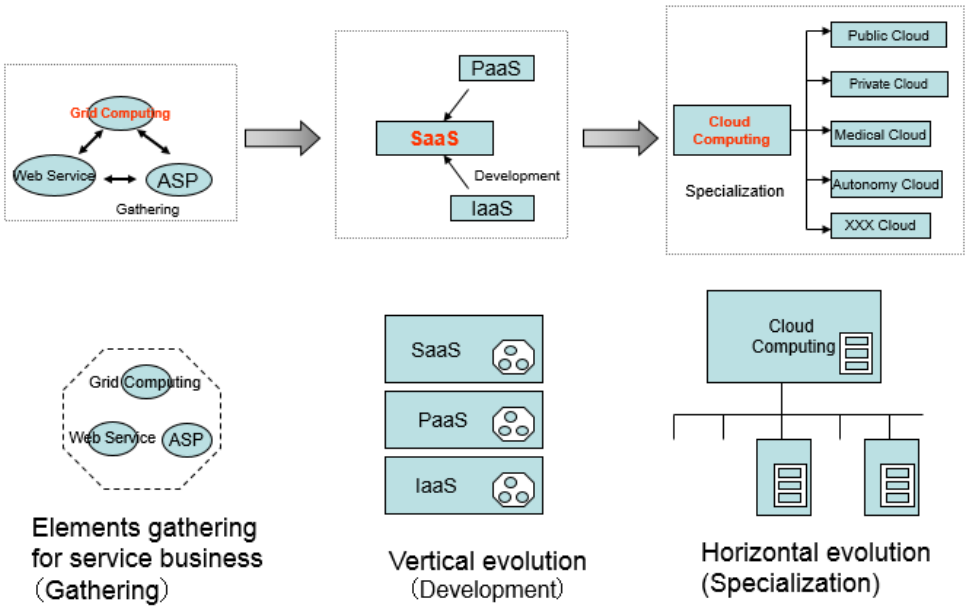

Figure 3.6: Concept evolution model

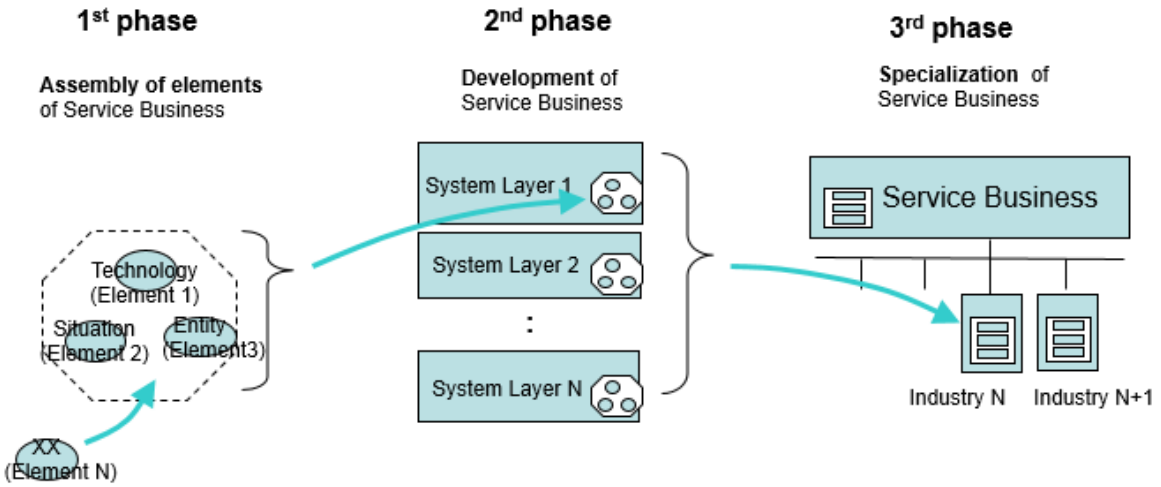

Figure 4.1: Concept evoution model

According to the results of this case study, the components of service business congregated at an early stage. All keywords regarding technology, business formation, and entity, which are necessary to build a service business, appeared and were gathered. In the next phase, these concepts evolved into a new concept as one unit. Following the new concept (i.e., SaaS) , keywords on a different technical level were generated for compensation. Finally, all keywords at each technical level merged into one unit and created a new keyword (i.e., cloud computing) , but the concept evolution was different from the previous one and was classified and specialized depending on each industry.

These results indicate that there is a possibility to know where the technology is in its evolutionary process. If we observe the situation of a certain keyword and identify the phase it is in, we can realize how far the concept has matured.

When we observed the developmental status of cloud computing in comparison with SNS-related keywords, the development of the user environment around computing cloud also be noticed. The IT environment was changing from a server-centric position, past the PC generation, to where the smartphone becomes the key entity. In the computer world, the unit of technology granularity and services is moving from the organization to the individual with the evolution of social networks.

According to Umemoto [16], the activity entity of knowledge management has spread to private and social levels from the organization and group levels in recent years. Note that the term “individual” indicates people who do not belong to the organization or enterprise. Even though they

belong to something, they are separate from the work organization and have instead related to an open source or some other intellectual creative team as a hobby. More specifically, as depicted in Figure 4.2, a knowledge ecosystem in which the individual and society operate and mutually strengthen each other has been born, and the driving forces of the ecosystem are the Internet and the Web.

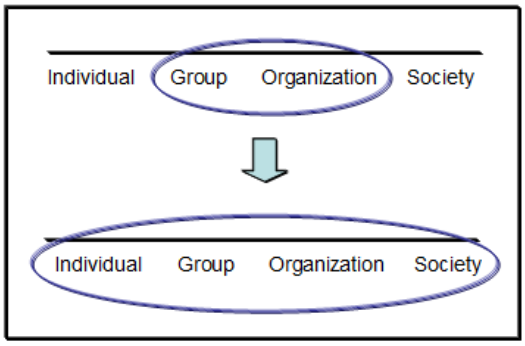

Figure 4.2: Expansion of knowledge management objects (from Umemoto [16])

By adopting this abovementioned factor of knowledge management along the horizontal axis of the aforementioned model, we arrived at Figure 4.3. Through the concept evolution, interoperability and inter-strengthening between the individual and society are becoming an essence of human intellectual activities. The equipment and devices have been simplified by the development of computing and reached the current concept of BYOD. Intellectual creative activities by an organization have moved to the creative activities of the individual; i.e., it has shifted from a macro level to a micro level.

B. Investigations

As mentioned in Chapter 1, we interviewed three experts in the IT industry (i.e., N. Yashima, M. Iseri, and S. Takeo) to confirm our analysis results. Portions of our interview are given below.

"Cloud computing is not a marketing term and instead is something that is derived from technical terminology. After a time period in which market needs have increased, the possibilities and capabilities of cloud computing have been expanded. Cloud became a concrete concept. Whenever a term points only to technology, there is no choice but to decode it; however, once the range spreads, cloud entails economic matters, security matters, and so on. The scale of the concept becomes large enough from all angles, and everybody can describe something about cloud computing by traversing view to view." (M. Iseri)

"SaaS is a specialized concept with limited meaning, but when people mention cloud computing, they think of it freely. The definition of cloud is very wide, so it may cover areas that have no direct relation with cloud computing. In other words, the relevant terms used before cloud computing had been too specific to afford existing together." (S. Takeo)

"IT terminology has a tendency to exist in article titled despite having little or no relation to the contents of the given article. And these terms are repeatedly adopted in magazines, especially in newspaper, which having huge influence. For words that are too specific, it is difficult to exist together. This is important, to the point that x-cloud is an outcome of the maturity of this evolution." (N. Yashima)

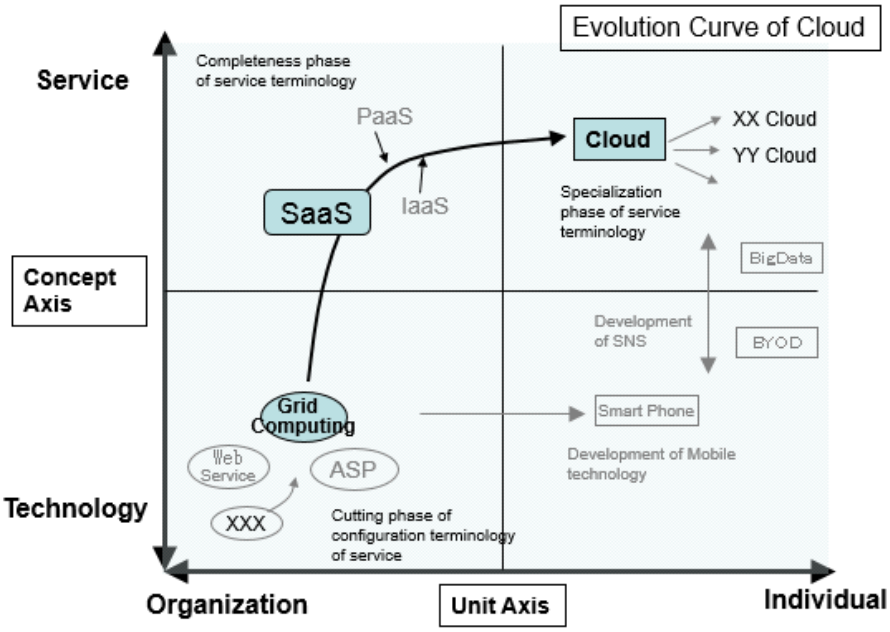

Figure 4.3: Evolution curve of cloud computing concept

"The internet contributed to the expansion of IT keywords. There are several keywords devised by journalists, but the ones selected by the era remain. There is huge difference between the pre-Internet and Internet periods, because a journalist in the Internet period can access volumes of articles, and can then write the given keywords repeatedly. Though the trend of keyword has already moved to cloud computing these days, some still consider cloud computing to be the same as SaaS. Cloud is not the same as SaaS. If people recognize that cloud computing and SaaS to be the same without correctly knowing cloud computing, they would be considered outdated in the theory of evolution." (M. Iseri)

Specifically, a concept keeps evolving by expanding some notions. Grid computing or SaaS has been changed by such business occurrences owing to the popularization of mobile devices or cost reduction of storage devices; next, grid computing and SaaS then eventually evolved into cloud computing and fixed the concept.

V. CONCLUSIONS

A. Summary

In this research, we analyzed IT keywords in a span of over a decade via text mining techniques, focusing on the path that the concept of cloud computing had paved over time. Based on this analysis, we modeled the circumstances of evolution from technology concept to service concept, as illustrated in Figure 4.1 above.

One of the factors of change in business environment is the computer terminal. In recent years, the mainstream has shifted from notebook PCs to smartphones and tablets. Users were once limited in their use of such devices, but now they have become independent of time and place. Nowadays, the number of enterprise server shipments is decreasing, whereas the Internet access from mobile devices is expanding. With the development of cloud computing, usage patterns of mobile users has also evolved. Private mobile devices are leading the way as terminals, including in businesses. BYOD, which appeared in 2012, exhibits such phenomena. In the past, individuals could not dispatch information without special techniques, but now everyone can expediently dispatch information via blogs or Twitter. Further, information was subdivided each that necessary information became easy to procure for everyone, and, as such, the speed of life increased.

In the past, the unit of business was the organization, and the activities of daily life were performed in an organized environment. The center of business has shifted to the individual with the development of social networks. Individual behaviors and their speech are collected and analyzed, and the analysis results can be instantly reflected in the next scene. The movement of the business environment that possesses this social network supports the concept evolution toward cloud computing from another angle. Though businesses generally run as a company and organization, business elements have shifted from organization to the individual.

B. Theoretical and practical connotations

The theoretical connotation of this research is that the evolutionary process of a concept in the IT industry has been demonstrated and modeled with a focus on cloud computing by analyzing data using text mining techniques. The evolution is explained as the subject transition from the organization to the individual by superposing the concept of cloud computing model on the concept of social networks.

The practical connotation here is that planning business strategies and actions by referring to the evolutionary case of cloud computing concept may be possible. Besides this, few appealing concepts may be expected to attract other researchers such that the method leads to industry implementations.

C. Future research

We have presented the evolutionary model of cloud computing. Based on the literature review, to the best of our knowledge, there are no previous reports resembling our current research, because there is no experiment that has analyzed data for keyword trends and industry status. In the future, we aim to model the evolution of SNS and this make cloud computing model even clearer. Also, we feel studying the evolutionary process of the new concept of big data is meaningful.

Through this work, devising an evolutionary model that is further generalized via the collection of further evolutionary patterns will probably become possible. If we continue this research and obtain such generalized patterns in concept evolution, we expect to discover where a given concept is on evolutionary stage and will be able to predict future developments in service business.

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