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Scientometrics Analysis through CiteSpace on Internet Product Service Quality

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Abstract

Lifestyles and jobs are becoming increasingly dependent on Internet products as information technology advances and networks become more widespread. Despite the popularity of internet products, little attention has been given to its service quality or customer satisfaction. To get a systematic review of the study, a CiteSpace-based study was conducted over the last decades. Relevant keywords were used to search articles at the "Web of Science" for nearly ten years and conducted manual screening, and finally obtained 331 valid articles. Then, CiteSpace were used to analyze these data. With this advanced data analysis tool, a different view was displayed with research topic, analysis method and measurement model. The results show that Internet products are tightly linked to e-commerce, and that consumers (particularly user satisfaction) receive significantly more attention than the quality of the products themselves. Meanwhile, this study discovered the analysis methodologies typically used in Internet product research: meta-analysis and sentiment analysis, as well as evaluation models of service quality: the IS Success Model and E-S-QUAL. These finding provides beneficial methods and models for the development of Internet products and the evaluation of service quality, as well as a better understanding of the product development of online applications and a plethora of knowledge about the Internet of Things.

Keywords: Internet product, service quality, CiteSpace, design process.

Introduction

The progress of network technology and mobile terminal technology has greatly promoted the development of mobile internet and its products. In reference to App Annie CO., more than 194 billion apps were downloaded worldwide in 2018, up 35% from 2016. According to Statista, there were 267.6 million mobile internet users in the US in 2019, with a mobile internet penetration rate of 81.3%. Internet products have had a profound impact on people's lives.

The Internet Product is a general term, which includes APP, e-commerce, e-government and other internet-dependent websites, applications, systems and other products. Current studies indicate that service quality has positive effects on the behavioral intention of customers (Schäfer & Klammer, 2016; Walsh et al., 2018; Witell et al., 2017). Research on the service quality of Internet product can promote the development of this industry. Researchers have paid much attention on the interaction connection between users and products. For example, Tam et al. (2019) tested the role of systems, information and service quality in e-commerce use and user satisfaction. Wu et al. (2021) applied a "stimulus-organism-response" model and motivation theory, to examine how website service quality influence the stickiness intention of website users. On the other hand, some researchers explored different measurement dimensions and influencing factors of Internet products, and created such as "IS Success Model" (DeLone & McLean, 1992) (DeLone & McLean, 2003), "E-S-QUAL" (Parasuraman et al., 2005) etc.. But in generally, we haven't found a review of the literature about service quality of Internet products, which

would clarify its evolution and help us understand its current state.

This paper reviewed the literature on service quality of Internet product in Web of Science in the last ten years by a method of bibliometric. Bibliometric analysis is a commonly used method for researchers to review literature. It uses visual tools such as VosViewer, Copalred, CiteSpace, etc. to get links between articles, authors and institutions, as well as data on word frequency and citation volume by investigating the keywords of articles in different fields, and then the important information in a specific field can be obtained, for instance, the research hot spots and the influence of articles in a period of time. Therefore, bibliometric is effective for researchers to grasp the current research and predict the future direction.

The main objective of this paper was to identify the most influential studies in service quality of internet product, including hot issues, popular industries, common methods of research, and other both broad and specific issues. Then, we explored the design process of internet product, as well as the design implement for IoT applications.

Methodology

We have established and designed the retrieval strategy, and searched the articles of Web of Science in recent ten years with “Internet Product” or “its synonym” + “Service Quality” or “Quality of Service” as the retrieval topic. Although internet is used as a tool or medium in almost any industries, we have not set up specific disciplines to ensure that the Internet Product covers as comprehensive contents as possible.

In order to further ensure the level and profession of literature materials, we excluded reviews and books, and only retained articles. Then, we filtrated the papers manually according to their titles and keywords, and deleted the papers that were not related to Internet Product obviously. Finally, 331 valid literatures were obtained.

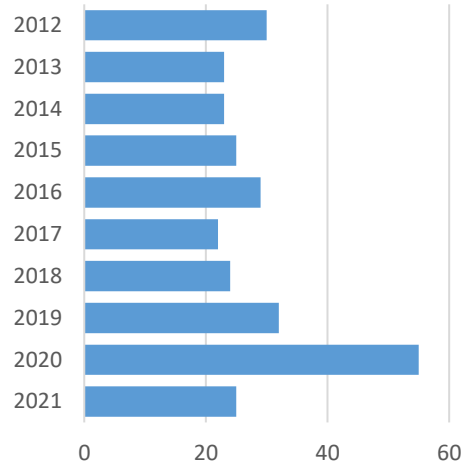

Figure 1. *The Number of Documents from 2012 to 2021*

Figure 1 shows that the number of documents of Internet Products published on the WoS from Jan. 2012 to Jun. 2021 every year. It remained at a stable level basically in the past few years but in recent three years, the number of articles increased significantly. It indicates that people's attention to Internet Product is rising.

Figure 2 indicates that the publishing fields of Service Quality of Internet Product mainly focus on Computer Science, Engineering, Business Economics and other directions, especially Computer Science monopolize 62.84%. This is because Internet has a natural and inseparable relationship with Computer Technology.

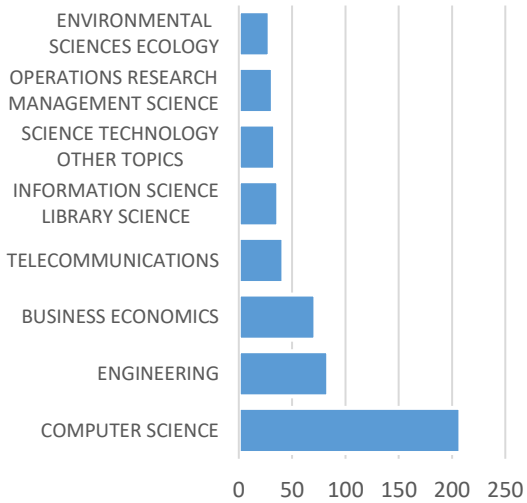

Figure 2. *The Number of Documents from Different Research Direct*

In this paper, we illustrate a bibliographic map of internet product by CiteSpace. CiteSpace is a visualized citation analysis software commonly used in bibliometric. It can analyse the basic knowledge contained by scientific literature, discover citation hot spots in publishing field, decompose the network into clusters, etc., and then present these results in a visual form. These results include collaborations between institutions and authors, co-citation networks and so on, which and literatures were cited network, which can help researchers identify the rapid growing subject areas (Chen, 2006).

We used four functions of CiteSpace, which are literature co-citation, cluster analysis, keyword co-occurrence and keyword burst, to make a visual analysis to the 331 articles.

Results and Discussion

Literature co-citation means that two or more articles are cited by one or more subsequent papers at the same time. By analysation of literature co-citation, papers with high citation frequency can be screened out, i.e. important papers that have been widely recognized. At the same time, we can find the connection among literatures, and the strength of the connections. Table 1 shows the top 10 frequent co-cited documents from 2012 to 2021.

Table 1. *Top 10 Frequent Co-cited Documents in Service Quality of Internet Product*

Author (year)	Title
Hausman AV (2009)	The effect of web interface features on consumer online purchase intentions
Bernardo M (2012)	Functional quality and hedonic quality: A study of the dimensions of e-service quality in online travel agencies
Guo SS (2017)	How Doctors Gain Social and Economic Returns in Online Health-Care Communities: A Professional Capital Perspective
Ahn T (2007)	The impact of Web quality and playfulness on user acceptance of online retailing
Wang WT (2016)	The stickiness intention of group-buying websites: The integration of the commitment–trust theory and e-commerce success model
Teo TSH (2008)	Trust and Electronic Government Success: An Empirical Study
Ha S (2009)	Consumer e-shopping acceptance: Antecedents in a technology acceptance model
Cao XY (2017)	Online selection of a physician by patients: Empirical study from elaboration likelihood perspective
Fang YL (2014)	Trust, Satisfaction, and Online Repurchase Intention: The Moderating Role of Perceived Effectiveness of E-Commerce Institutional Mechanisms
Zhou T (2013)	An empirical examination of continuance intention of mobile payment services

People pay attention to the quality of e-service not only from the functional dimension, but also from the entertainment dimension. Hausman et al. (2009) figured out that the current (2009) study emphasised both utilitarian and hedonic characteristics. Bernardo et al. (2012) considered that hedonic quality is an intrinsic dimension of e-quality, and one of the dimensions of assessment of e-quality. Ahn T (Ahn et al., 2007) found that playfulness is important in enhancing user attitude and behavioural intention to use a site. Ha and Stoel (2009) found that Shopping enjoyment and trust play significant roles in consumers' adoption of e-shopping.

In online health-care (OHC) area, Guo et al. (2017) examined the effects of status capital and decisional capital (two dimensions of professional capital) on doctors' social and economic returns. He found that the doctor's decisional capital is also an important professional component in maintaining exchange returns at OHCs. Cao et al. (2017) figured out that service quality and electric words of mouth had positive effects on patients' decision when selecting doctors online.

With the development and maturity of e-commerce, there are many researches on it. Wang et al. (2016) studied the factors that

influence users' stickiness intention on e-commerce websites, and found that stickiness relationship commitment, trust, and satisfaction were key determinants of stickiness intention. Zhou (2013) identified the factors affecting continuance intention of mobile payment, which are trust, flow and satisfaction determine continuance intention of mobile payment. Fang et al. (2014) developed a set of questionnaire and scale for online repurchase intentions.

On the other hand, e-government is also an important area of internet product. Teo et al. (2008) examined the role of trust in e-government success, and proposed and tested a model to assess e-government Web site success at the postadoption stage.

After literature co-citation analysis, cluster analysis is done by CiteSpace. According to it, we got some noun phrases, from which we can find research directions or hotspots in a period. The largest five clusters are listed in Table 2. Clusters are numbered from 0, i.e. Cluster 0 is the largest cluster and Cluster 1 is the second largest one.

Table 2. *Top 5 Clusters and Terms within the Clusters*

Cluster ID	Size	Top Terms (LLR)
0	39	meta-analysis (4.06, 0.05);
1	34	travel website (4.04, 0.05);
2	30	prior experiences (4.45, 0.05);
3	24	trust (4.85, 0.05);
4	23	product attribute beliefs (5.52, 0.05)

The largest cluster is "Meta-Analysis", which includes 39 articles. Meta-analysis is a quantitative approach of literature review (Blut, 2021). It can only synthesize findings from studies that produce quantitative findings; meta analyses summarize results of studies that report quantitative measures of variables and report descriptive or inferential statistics (Cooper, 2018). Meta-analysis is systematically conducted, and each step is carefully planned and documented. Compared with conventional studies, it has the potential to present findings in a more differentiated way, and can assess differences across studies that conventional reviews might not be able to detect. Meta-analysis often use computerized databases and professional software to analyze these data, so it allows the handling of a large number of empirical studies (Cooper, 2018; Lipsey & Wilson, 2000).

The second largest cluster is "Travel Website", which includes 34 articles. It indicates that in the study of service quality, website is one of the important fields researchers are focus on. On the other hand, from the perspective of industry category, the research of tourism is more active. Travel website is a primary interface between tourists and the tourism service department, which plays an important role. For example, through the Travel Website, tourists can learn about scenic spots in advance, book hotels, check other people's feedback and express their own opinions. From the perspective of user's satisfaction, a website should become more customer-oriented, and provide prompt service to tourists (Ku & Chen, 2015).

The third cluster is "prior experiences", consisting of 30 articles. Prior experiences are usually related to satisfaction and user perception. For example, customers' prior experiences with providers affect their satisfaction and loyalty. Customers who have a fixed service relationship with a provider usually attach more importance to their previous accumulated satisfaction than new information. And the longer they stayed in the relationship, the stronger the relationship and the more satisfied they were (Bolton, 1998).

The fourth cluster is "trust", which usually refers to the user's trust in the security and privacy protection of Internet products, and is one of the most important indicators in evaluating service quality. The last cluster is "product attribute beliefs". It has a crucial influence consumer-perceived value (Chen & Hu, 2010).

The following is a summary of the findings based on the co-citation cluster analysis: The study of analytical methodologies is known as "meta-analysis". The most common sort of Internet product is "travel websites". The study focuses on user perceptions of "prior experience" and "trust", as well as "product attribute beliefs" based on product

characteristics. As a consequence, the current study gives more attention to the user's perception (previous experience & trust) than the product characteristic (product attribute beliefs).

Key words are one of the important contents of a paper. We used CiteSpace to analysis the keywords of literature data, and merged the co-occurrence keywords with its synonyms, such as "satisfaction" and "customer satisfaction", which were merged into "satisfaction". Finally, the co-occurrence network diagram of the keywords is illustrated. (Fig 3). The larger the font size in the diagram, the higher the frequency of its occurrence.

Figure 3. *Keywords Co-occurrence Network*

Table 3 lists all key words that occur more than 8 times, and classify these high-frequency words into three categories: "Impact Factors", "Products & Objects", and "Evaluation Models & Methods".

The Impact Factors of service quality of internet products, "satisfaction" is the first, up to 119 times. This indicates that satisfaction in the evaluation of products and services is paid the most attention. Many researchers took the satisfaction of Internet products and services as one of their goals and found out the factors that affect satisfaction in different fields and conditions (Zhou, 2013). Some people have also established a relationship between satisfaction and engagement intention, value perception and trust, and explored their mutual influence (Wang et al., 2016; Zhou, 2013).

Table 3. *Keywords Category in Service Quality of Internet Product*

Category	Keywords	count	centrality
Impact factors	Satisfaction	119	0.01
	intention	63	0.19
	acceptance	61	0.16
	perception	55	0.17
	trust	51	0.08
	loyalty	32	0.19
	performance	25	0.16
	antecedent	25	0
	technology	24	0.27
	word of mouth	20	0.08
	design	8	0.05
	information quality	8	0.03
Product & Object	e-commerce	62	0.16
	website	32	0.05
	e-government	7	0.01
Evaluation Model & Methods	information systems success	59	0.02
	multiple item scale	25	0.08
	sentiment analysis	8	0.04

In general, the impact factors with high frequency are mostly studied from the perspective of users, such as "satisfaction", "Intention", "Acceptance", "Perception" etc. Meanwhile, the factors of products such as "technology", "design" and "information quality" appear less frequently. This illustrates that the focus of our current research is on users rather than products attribute.

Centrality, which is an index that evaluates the relevance of nodes in a network, is the major link between two different sectors. The

relevance of "technology", "intention", "loyalty", and "perception" as effect variables is relatively high, implying that these features are recognized as highly important influencing factors in numerous disciplines of service quality research.

The main research object of internet product is "E-commerce", which indicates that commercial activities online is an important area. "Website" is a traditional form of Internet products. Its popularity shows that, despite the onslaught of mobile applications, website is remaining a mainstream.

In terms of evaluation methods, Information Systems(IS) Success Model and Multi-item Scale are the main methods of Internet product service quality at present. IS Success Model was first presented by DeLone and McLean (1992) in 1992, aiming to measure the complex dependent variable in IS research. In 2003, they improved this Model, and pointed out that quality has three major dimensions: "information quality," "systems quality," and "service quality." Each should be measured - or controlled for – separately (DeLone & McLean, 2003). The second largest method is "multiple item scale". It was first developed by Parasuraman in 1988 as a 22-item tool, called SERVQUAL, for assessing customer perceptions of service and the quality of service of a retail organization (Parasuraman, 1988). Similarly, they created another multiple-item scale(E-S-QUAL) in 2005, for measuring the service quality delivered by Web sites on which customers shop online (Parasuraman et al., 2005).

Another useful finding according to CiteSpace is burst and evolution of keywords, which means that a keyword appears in a high frequency in a certain period of time. It can reflect the rise and evolution of a keyword. As seen from Figure 4, the frequency of keyword burst in recent ten years is relatively continuous.

Figure 4. *Keywords with Strong Citation Bursts*

"User acceptance" was the hot word from 2012 to 2014. User acceptance includes the acceptance of usefulness, ease, value, risk etc. "E-commerce" is burst from 2013 to 2016. "Customer" and "word of mouth" are from 2018 to 2019. These can be regard as a concentrated outbreak of business research, such as business environment, consumer feelings, intentions, online reviews, etc., are the hot topics of that five years. "Sentiment analysis" broke out in 2019-2021, indicating that the research on Internet products has focused on sentiment analysis in the last two years. Sentiment analysis is becoming an essential tool for analyzing the contents of online customer reviews. By identifying the necessary tags, we can determine the emotional intention of this comment and the intensity of sentiment expression (Zaki Ahmed & Rodriguez-Diaz, 2020).

The Internet product development process includes requirements analysis, product design, product development, testing, and iteration. The results of this paper's data analysis cover all of the essential links in the development of Internet products, and may be used as guidance and inspiration for these links.

During the requirements study stage, the burst of keywords offered a sentiment analysis technique for analyzing user demands, competitor products, and market wants, in addition to direct market research. It utilizes sentiment analysis to uncover consumers' pain points and product innovation areas, as well as find market demand and serve as one of the most important foundations for product iteration, by collecting data from user comments on Internet products.

At the product design and development stage, the key words produced from the Keyword Co-Occurrence Network analysis re-emphasize the design idea of "user-centered," in which considerable attention should be paid to the user's satisfaction, intention, acceptance, and so on. At the same time, product attribute beliefs (technology, design, and information quality) are crucial internet product content.

When testing the internet product, in addition to standard tests on product function and operation quality, we can use commonly used evaluation methods discovered by Keyword Co-Occurrence Network (such as multi-item scale) to investigate internal small batch users and test

the service effect of Internet products from the perspective of users.

The results of this paper's data analysis are equally instructive for IoT-based applications. The IoT signifies to an overall system of interconnected physical Things utilizing existing correspondence conventions (Asghari et al., 2018). It combines intelligent objects with sensors, networking, and processing technologies to provide an intelligent service environment for end users. All these facilities and services are delivered through various applications executing in the Internet of Things environment (Asghari et al., 2019).

IoT services can be integrated into application level, network level, and sensing level. The application level includes one or more services of applications, so its service quality can be evaluated through traditional indicators (Ling Li et al., 2014). The findings of this paper have the following implications for IoT：

1、 To pay attention to the users as well as the technology. We can find from the Keyword Co-Occurrence Network that almost all words related to service quality, such as “satisfaction”, “intention”, “acceptance”, and so on, are related to users' subjective perception, implying that users' perception is closely related to service quality; at the same time, the centrality of “technology” is very high, implying that technology is an important factor affecting Internet product in many industries.

2、 To assign a high priority to the web application. After analyzing co-citation clusters and the Keyword Co-Occurrence Network, we determined that web is a critical phrase. In the Internet of Things application, it is expressed as a web application. Mobile devices may provide more convenient user services due to their small size and mobility, but their battery capacity and storage space are limited, which limits the development of mobile apps based on the Internet of Things to some extent (Anitha & Padma, 2020; Hasani et al, 2020).

3、 To assess service quality of the IoT application frequently. The Keyword Co-Occurrence Network reveals common evaluation models, such as “IS Success Model”, “Multi-item Scale (E-S-QUAL)”, and others, all of which are important to IoT applications. The improved IS Success Model might be used to assess IoT applications.

Conclusion

Service quality is an important evaluation index of Internet products. To get a systematic review of service quality for online applications, this study experimented a scientometrics analysis through CiteSpace. The result shows that e-commerce and user perspective were paid more attention than others. We conducted that user-based research is significantly more extensive than product-based research. More factors come from users such as “satisfaction”, “intention”, “acceptance” were got more focus than those from internet products such as “technology”, “design”, “information quality”.

Meanwhile, we also conducted the relevant research status of Internet product. It comprises the fact that the research objective is mostly e-commerce; the research perspective is primarily user perception; and user-based research is much more than product-based research. Because internet products are the primary means of delivering services, future research should place a greater emphasis on product quality.

Also, we revealed a literature review method used by high frequency: meta-analysis. It can present differentiated research results more clearly and figure out differences that traditional review may not find. Meanwhile, sentiment analysis was conducted to be important, which can determine consumers’ affective inclinations by analysing online comment content. Though not widely used in the past 10 years, it is bursting in the last two years, which is worthy to pay close attention to it. Also, IS success Model and A Multiple Item Scale (E-S-QUAL), which are commonly used to measure service quality of internet products, have been adopted and expanded widely.

In addition, implications can be taken out for development process of internet products. A sentiment analysis method for analysing users’ needs, a theory for designing and developing, a measurement model for testing the quality are summarized in this paper. Furthermore, paying attention to consumers' perceptions and technology has some enlightening implications for the design of Internet of Things. Also, the revealed evaluation model（IS success Model,

E-S-QUAL etc.） may be used to assess the service quality of Internet of Things applications.

Although our study has interesting implications, it has some limitations. As the papers were retrieved from WoS, some important articles not from it would be left out. In addition, the keywords we select according to our research topic may not be exhaustive. Therefore, expanding database and keywords could lead to a more comprehensive result in this field.

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