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User Experience Elements of Data Visualization Large Screen: The Example of Electricity Industry

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ABSTRACT

In the era of big data, all sectors of society pay more and more attention to data value. Data visualization, as the most effective way to present data value, has been given an important position.The electricity industry has many sources of data, complex dimensions and large scale. It is necessary to present massive data clearly, scientifically and accurately through the visualization system. Therefore, it is very important to establish a set of data visualization large screen product evaluation element model based on user experience to improve user satisfaction. This paper mainly collects the user experience elements of the large screen of electricity industry data through user interviews, and uses the card sorting method to establish the element model, which is convenient to quantify the user experience of the large screen of electricity industry data visualization, and realize scientific evaluation of user experience results.

Keywords: Data visualization large screen, User experience, Electricity industry

INTRODUCTION

As one of the intuitive display forms of data visualization technology, data visualization large screen can display complex multi-source data in a vivid and friendly way through real-time transmission and dynamic interaction within a limited window. By extracting effective information and mining hidden business associations, business scenarios are presented in a reasonable layout.Its technical difficulties lie in the rationalization of data display, the logic of information presentation modes, and the convenience of user understanding. Therefore, the purpose of this paper is to establish the user experience element model of data visualization large screen in the electricity industry, and provide examples and references for the quantitative research of user experience of data visualization large screen products.

CORE CONCEPTS

Data Visualization Large Screen

Data visualization is a technology that makes the correlation between big data content and data easier to understand and analyze by means of charts, maps, videos and other data representation forms. Its presentation forms can

be divided into descriptive, mining and interactive (Lina et al., 2020). As the display carrier of data visualization, data large screen has become the essential basic core system of data visualization (Guangwei, 2018).

User Experience Research

User Experience Overview

According to ISO 9241-210, user experience is "people's cognitive impression and response to the products, systems or services they use or expect to use" (User experience, 2018). Although the concept of user experience itself is subjective and vague, from the perspective of evaluation, it is necessary to explore the dimensions of user experience evaluation and divide a complex system into multiple indicators to reflect the comprehensive situation.

User Experience Elements

As for the constituent elements of user experience, Robert Rubinoff believes that user experience elements include usability, functionality, content and brand. These elements are not only related but also affect each other (Rubinoff, n.d.). Moeslinger believes that user experience factors include user's behavior, sense and emotional experience, and have a great correlation with the use environment (Fanfan, 2012).

EPI User Experience Element Model

The EPI user experience model was proposed by Professor Xin Xiangyang of Jiangnan University. The EPI model requires the user experience designer to consider the user experience as a whole.When designers think about interaction design and user experience, they no longer only focus on whether the product is easy to use, intuitive, simple, natural and other aspects. Experience can be divided into expectation, progression and influence according to the process (Xin, 2016). The data visualization large screen of the electricity industry includes hardware systems, supporting software, people, space environment and platforms, etc. It emphasizes personalized and customized data visualization user experience, focuses on different business segments.Data visualization large screen can connect business content story lines through visual perspective, reflects core links, and provides users with different experiences.

(a) Expectation: The expectation is the first stage of user experience. The user's expectation of the product is directly related to the product's quality of the experience. The final user experience index is higher than the user's expectation, and the user will feel happy. The final user experience is lower than the user's expectation, and users will show disappointment, dissatisfaction and other emotions.According to the EPI model, in expectation stage, the secondary experience elements include three: needs, first impressions and expectations.
(b) Progression: The progression is the second stage of the user experience. It mainly refers to various experiences generated by users directly using a

product, and the research on usability is also based on this stage. According to the EPI model, there are many secondary experience factors in progression stage: path, presentation mode, feedback, interaction mode, duration, goal, etc.

(c) Influence: The influence is the last stage of user experience. When a user experiences products or services, the experience will continue to accompany the user for a period of time, and even transform into a permanent memory. According to the EPI model, there are four secondary elements in influence stage: memory, emotional fluctuation, self-perception and self-change.

Overview of Electricity Industry Business

Development Status of Electricity Industry Business

The electricity industry has the characteristics of instant production and sales, numerous fields, geographical dispersion and huge organization (Hu, 2019). With the wide application of information technology, a large amount of high-value, multi-type, large-scale and cross-domain data has been accumulated in many application fields such as electricity. How to make full use of big data to realize the industrial structure upgrading of China's electricity industry will be an important topic for the development of electricity informatization in the future. The main characteristics of business data in the electricity industry are: large volume, multiple types, fast speed and security.

Data Types in the Electricity Industry

The main types of electricity industry data are as follows:

(a) Basic data: This type of data is mainly related to electricity equipment such as transformers and generators, which is the basis of decision-making of the dispatching center.

(b) Real-time data: This kind of data is generated in the whole operation process of the electricity industry, and needs to be equipped with large storage space to display the operation of the electricity industry (Kang, 2017).

(c) Daily management data: This kind of data mainly includes the data after handling the problems sorted by each department. It is generated in the specified range and provides real-time feedback on the operation status of electricity equipment.

(d) External data: This kind of data mainly generated from the Internet of Things, primary energy network, Internet and other networks connected with the electricity industry.

Existing Problems of Data Visualization in Power Industry

In terms of data visualization in the electricity industry, there are mainly the following problems:

(a) Data integration: Electricity transaction data are scattered in various business systems without effective unified management.

(b) Content release:The needs of regional information release and supervision can not be fully meet.It is urgent to access relevant basic data according to the current regulatory requirements, and increase the display content.
(c) Release method: Although the amount of data in the system is huge, it lacks multi-dimensional information presentation, and is poorly matched with user needs. A large amount of data does not really play its role.
(d) Display form: Each independent electricity system has different display modes, which are difficult to handle. The interaction between the system and the service object is poor.

Classification of Large Screen Users in Electricity Industry

By analyzing the core users of the data visualization large screen in the electricity industry, it is convenient to carry out specific user interviews. Through research, the following three core user types are summarized:

(a) Department managers: They pay attention to the business value and brand sense of the big data screen, the improvement of the coordination efficiency of department work, the mining and analysis of data, and the identification of data trends and potential risks.
(b) Daily business personnel of the department: They pay attention to the connection between the big data screen and daily work, and the convenience of data search and access.
(c) External visitors: They pay attention to the experience process of large screen visit, the relevance of large screen and department business content, and the visual display effect of large screen.

RESEARCH METHODS AND PROCESS

Research Methods

(a) Literature research: Literature research mainly refers to the method of collecting, identifying and sorting out documents, and forming a scientific understanding of facts through the study of documents (Shu et al., 2009).
(b) User interview: User interview is a research method to study the behavior habits of users and understand the views and attitudes of interviewees through face-to-face conversation with interviewees. This method is used to collect data describing the experience (such as the quality and reason of the experience, the content of the experience, etc.).
(c) Card sorting: Card sorting is a method for planning and designing user experience hierarchy. In this paper, it is mainly used to classify the factors that affect the experience and help sort out their logical relationship.

Detailed Research Process

According to the previous desktop research and the electricity business content, an interview questionnaire for the electricity industry personnel using the large screen of data was prepared. The semi-structured user interview

method was used to collect the users' views on the existing data visualization big screen, as well as the use experience and feedback when using the big screen to complete business needs.

User Interview

6 employees and leaders from a business department of the electricity industry in Wuhan were selected and invited to answer the following 8 questions (see Table 1). The answers obtained from the interview will be used to study the user experience influential elements in the process of user experience data visualization.

Refinement of User Experience Elements

By analyzing the first-hand information by sentence, the effective information is extracted and the obtained content is re-induced. Part of the interview content of a user is selected to show the refining process of user experience elements (see Table 2).

Through refining the experience elements of 6 recordings (8 questions each), the EPI element experience table of the data visualization screen (see Table 3) is finally summarized, and the tertiary elements correspond to the specific elements of the user experience.

The Table 3 combines the user interview conclusions. It is a simple summary of the experience elements that should be paid attention to when considering the user experience of the general data visualization large screen.

Card Sorting

The card sorting method can meet the user's classification of information as much as possible in a structured way.This study selected five user experience researchers to classify the collected user experience element cards.

From the collected user experience elements, at different stages of the user experience, the elements that affect the user experience of the large screen of

Table 1. Interview outline for large screen users of data visualization.

Stage	Problem
Expectation	- What is the data visualization large screen in your imagination? - What problem do you want the data visualization large screen to help you solve? - Tell me about your first impression of the data visualization large screen.
Progression	- Talk about your use process. - Do you encounter any confusion during use? Which processes confuse you? - What do you think of the existing data visualization large screen?
Influence	- What do you think is the greatest significance of this product for you? - Are you willing to recommend the data visualization large screen to other department personnel?

Table 2. Example of experience element extraction.

Time: May 18, 2022
Place of interview: In a business department of electricity industry in Wuhan
Interviewee: Mr. Ye
Position: Department managers
Background information: Mainly responsible for coordinating the business work of the electricity industry

First-hand information	Element extraction
Q: What do you think is the greatest significance of this product for you? A: The data visualization large screen can display the highlights of the department in a very scientific and cool way.This product can integrate the data of each business section, display the data in multi-dimension, improve the efficiency of work coordination, and facilitate data mining.It can well display the department's work achievements, honor and brand culture.	- Departmental influence - Brand sense - Improve efficiency - Cool vision

Table 3. EPI user experience elements list of data visualization large screen.

Stage	Secondary element	Tertiary element
Expectation	Need	Users have requirements for products
	First impression	Adapt to space environment, Impression of interface and vision
	Forecast	An estimate of the condition of the product, Cognition of similar products
Progression	Task path	The operation steps conforming to the user's mental model, Functional layout conforming to user habits
	Objective	Complete core task objectives, give full play to data value, and highlight department strength and work achievements
	Feedback	The system feedback is timely, Users are less confused, Easy to use, The form of feedback is interesting,
	Presentation	Storyline architecture, Cool visual performance, In line with the corporate culture, Sense of technology, Brand sense
	Interactive mode	The operation mode conforms to the use scenario, Interactive mode of users and products
	System performance	Data security, The system is stable and controllable, Rationality of system response time
Influence	Mood swings	Cause emotional pleasantness
	Memory	Product and experience differences are prominent, Emotional resonance
	Self-perception	Fulfillment, Identity
	Self-change	Make life and work more convenient

data visualization are different. The data visualization large screen belongs to the business technology product, and has its targeted adaptation scenarios. Both subjective and objective factors will comprehensively affect the user experience. Through the classification and analysis of these collected elements, combined with the characteristics of business technology products in the electricity industry, and based on the effectiveness of helping users achieve their goals, the user experience of large screen data in the electricity industry is divided into four levels: user emotion, user behavior, functional utility, and system performance. The specific screening criteria are shown in Table 4. By dividing the sorted user experience elements according to different experience levels and experience dimensions, the user experience element level and dimension classification of data visualization large screen in the electricity industry is obtained (see Table 5).

Table 4. Screening criteria for user experience elements of data visualization large screen in electricity industry.

Experience level	Screening criteria
User emotion	It can enables users to achieve goals with pleasantness
User behavior	It can provide users with interactive ways that conform to their cognitive rules
Functional utility	It can enables users to complete core tasks and achieve business objectives
System performance	It can provide users with a reliable, efficient and stable hardware environment

Composition of Data Visualization Large Screen's User Experience Elements in Electricity Industry

Organize the user experience elements around the four levels of user emotion, user behavior, functional utility and system performance.It is found that the experience elements mainly involve six dimensions: pleasantness, influence, interactivity, usability, operational efficiency and reliability. These six aspects can also be used as a reference classification method for data visualization product card sorting. By integrating the experience elements under different experience dimensions, the user experience elements of electricity industry data visualization large screen are summarized (see Table 6).

CONCLUSION

Through the research on the user experience elements of the current data visualization screen in electricity industry, the following conclusions are obtained:

(a) The problems of data visualization in electricity industry in data integration, content release, release mode and display form are analyzed.
(b) The paper collects user experience elements of each stage in the process of user's data visualization large screen experience. With the help of the

Table 5. The user experience element level and dimension classification of data visualization large screen in electricity industry.

Stage	Experience element	Experience dimension	Experience level
Expectation	The product can meet the business function requirements	Usability	Functional utility
	Product can match space environment	Pleasantness	User emotion
	Expectation of product visual sense	Pleasantness	User emotion
Progression	Easy to operate without written instructions	Interactivity	User behavior
	Timely feedback on operation	Interactive	User behavior
	Completing business objectives and core tasks effectively	Usability	Functional utility
	Story line architecture of products	Usability	Functional utility
	Less confusion and mistakes during use	Interactivity	User behavior
	Easy to operate and use	Interactivity	User behavior
	It meets my business needs	Usability	Functional utility
	It can be used successfully every time	Usability	Functional utility
	Interesting to use	Pleasantness	User emotion
	Data is safe and trustworthy	Reliability	System performance
	The system is stable and controllable with fast response	Operating efficiency	System performance
Influence	It feels particularly cool.	Influence	User emotion
	I will recommend it to other departments		
	Impressive	Pleasantness	User emotion
	Enjoy using	Pleasantness	User emotion
	In line with corporate culture and strong sense of brand	Influence	User emotion

EPI experience element model, the EPI experience element table of data visualization large screen products is summarized.

(c) The card sorting method is used to classify and summarize the elements that affect the user experience of large screen data visualization in the electricity industry. Around the four experience levels of user emotion, user behavior, function experience and system performance, the experience elements mainly involve six dimensions: pleasantness, impact, interactivity, availability, operating efficiency and reliability.Finally the paper forms the data visualization large screen user experience element table suitable for the technical product characteristics of the business electricity industry. It is convenient to quantify the user experience of

Table 6. User experience elements of data visualization large screen in electricity industry.

Experience level	Experience dimension	Experience element
User emotion	Pleasantness	- Beautiful interface and cool animation effects - High user satisfaction - Good experience of space environment
	Influence	- Good brand style and impression perception - Presentation of enterprise value - Willing to share products
User behavior	Interactivity	- Users can easily identify data indicators and key information - Easy to operate and use - Less misoperation
Functional utility	Usability	- Clear story line structure - Completing core tasks
System performance	Operating efficiency	- Stable system performance and timely feedback - Fast page animation rendering and short response time
	Reliability	- The system is safe, reliable and confidential

the data visualization large screen in the electricity industry in the later stage, transform qualitative problems into quantitative research, and realize the visualization of user experience results.

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