

**Based on grounded theory and Python user
evaluation Research methods for smart desk design**

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1 Introduction

1.1 Background

"The current consumption of smart desks in Chinese homes has annual sales of \$32.4 billion." (Samrt home .2023) The sales situation shows an upward trend. With the times and the progress of science and technology, smart desk has become the new trend of the current social development, in order to enhance the convenience of human life, intelligent smart desk is increasingly becoming a must-have product of the smart desk in the smart era, with the progress of society, the level of human consumption is gradually transformed into the personalization of the smart desk products and humanization, smart home to the matching of the user's way of life can greatly improve the user experience The user-centered design concept is gradually being emphasized by designers.

Currently part of the family smart desk is too uniform in shape and the user experience is too complex. In addition, too unified design may not be suitable for all family style and personalized needs. And overly complex features may lead to a complicated user experience and expensive. Big data contains valuable product feedback, user preferences and other information that can guide the innovative design of smart desk products. Therefore, it is especially necessary to study the method of designing home smart desk products oriented to user demand experience.

1.2 Research purposes

The purpose of the analysis of smart desk user reviews by ground Theory and Python Data Mining is to provide in-depth user insights and suggestions for improvement. The main goal of the research is to explore and develop new methods and processes for smart desk design that should be based on an in-depth understanding of the diversity of user needs, changes in the social environment, and cultural differences, aiming to promote a symbiotic experience between users and smart desks. This includes understanding and incorporating the user's home style and individualized needs, especially in the context of Chinese culture, and how the design can meet the user's diverse and individualized needs while promoting emotional connection and long-term use.

2 Research methodology

2.1 Grounded Theory Overview

In Grounded Theory, the generation of hypotheses is ground in inductive quantitative analysis and the construction of theory. It involves formulating probabilistic statements that describe the underlying patterns of social behavior. As a type of analysis focused on latent structures, Grounded Theory uncovers these patterns within both substantive and formal contexts. This process entails conceptualizing findings from empirical data and integrating these concepts through theoretical coding into the developing theory. Hypotheses can then be expressed quantitatively or qualitatively,

depending on the nature of the data and the researcher's approach. The inductive process of data collection and analysis at the heart of ground theory is the methodological fulcrum for the systematic generation of hypotheses. The skill of the ground theorist is to abstract concepts by leaving the details of the data behind, elevating the concepts above the data, and integrating them into a theory that explains the underlying social patterns behind behavior in the substantive domains. The result of ground theory research is not a report of facts, but a relationship between concepts regarding the Probabilistic statements are generated a set of conceptual hypotheses developed from empirical data." (Holton, J.A. 2008)

3 Use of grounded theory research methods for smart desk design

Users in the process of using furniture for the functionality of the higher demand, such as comfort, operability, human-computer experience. In the product, office furniture is "from the inside out" to provide users with a sense of comfort, such as modular free combination of functions of the desk, allowing users to freely combine, suitable for their own way. Office furniture, even if the appearance of the shape, consumers at first glance on the not so surprising, but the enterprise can still be through the internal structure of the innovation and comfort enhancement, the achievement of corporate branding and consumer loyalty cultivation, contributing to the consumer's pursuit and love.

Data Collection

To investigate people's understanding of the concept of symbiotic smart desk and user needs, the traditional data collection methods of questionnaires and on-site tests are limited in content and insufficient to obtain people's views and perceptions of the dynamics of the symbiotic smart desk, so in-depth interviews were used for data collection and question adoption. The interview questions were conducted in the following order. 1. People's functional needs for desks and their reliance on them reveal the close interaction between people and furniture. 2. the demand for smart desks shows how furniture adapts to the needs of all users, including family members. 3. perceptions of symbiotic smart desks reflect understanding and perceptions of design concepts that promote harmonious coexistence between people and furniture. In order to record the questions and answers in the interviews in detail, permission was obtained from the interviewers in advance, and the interviews were recorded through screenshots (online interviews) and audio recordings (offline interviews).

Young people are the main group of consumption now and in the future, many young people choose to buy smart furniture desks in their life, or they have the idea of buying smart furniture desks in the future, based on this, the interviews in the study were chosen mainly for the age of 18 to 35 years of age of the crowd with a certain degree of economic ability and decision-making ability. Through the combination of online and offline interviews, 300 respondents were randomly selected online or offline (Suzhou City) for in-depth interviews of 30 minutes to 60 minutes, between December 25, 2024 and March 31, 2025, the interview time. The research subjects of

the article were 12 interviewees of all ages randomly selected from four categories, as detailed.

Data Processing

Considering the younger generation's preference for technology and their quest to enhance the comfort and efficiency of their work environment, we hypothesize that the majority of respondents will express a high level of interest in smart desks. Smart desks, as a tool that can optimize the work experience and increase productivity, are expected to gain widespread attention and popularity among young professionals.

Category coding and modeling

The research process of grounded theory is usually divided into four steps: formulation of the research question, data collection, coding, and theory construction. In the ground theory approach, coding is the process of comparing concepts, which leads to the formation of additional categories and conceptualization of the data.

Open coding

Open coding, also known as Level 1 coding, is applied to the analysis of smart desk user preferences in this study. Based on the methodology of first-level coding, the group plans to randomly select a certain amount of response data from future interviews to construct a model of the factors that influence users' choice of smart desks. Specifically, it is planned to randomly select a portion of the collected question-and-answer data as the basis for model building, and another portion for model testing. Through the steps of selecting, conceptualizing, categorizing and attributing, and conceptualizing categories of the interview data, it is expected that key factors influencing users' choice of smart desks can be identified and a number of specific categories can be formed. This approach will help to provide an in-depth understanding of users' needs and preferences for smart desks and provide data support for product design and marketing strategies.

Spindle Coding

Spindle coding involves the process of connecting and threading the concepts together. Therefore, in future studies of smart desk user preferences, a principal axis coding approach will be used to analyze the logical and causal relationships between the main categories and conceptual categories identified in the first level coding stage. Through this analytical process, we expect to be able to categorize and finalize these relationships by identifying main categories such as productivity, comfort, technology integration, personalization needs, and environmental adaptability, and organizing them into several dimensions such as functional needs, personal preferences, and technological factors. This approach will help us gain a deeper understanding of the intrinsic and extrinsic drivers that determine users' choice of smart desks, providing a scientific basis for subsequent product development and market strategy formulation.

Selective Coding

The application of selective coding, also known as tertiary coding, in smart desk user preference research involves the main categories obtained through constant comparison and analysis of the spindle coding stage. For the specific objectives of the study, "users' demand for smart desks" was positioned as the core category. By refining the logic of the study, we expect to reveal the following: users' individual characteristics and functional needs are the subjective internal drivers that influence users' choice of smart desks; the need for social interaction in the workplace and respect for technology are the external drivers; and social media and other digital platforms act as mediators that indirectly influence users' choice of smart desks. Based on the interrelationships between these categories, we will construct a comprehensive model on the factors influencing users' demand for smart desks. This approach aims to provide an in-depth understanding of user demand and a scientific basis for the design and market positioning of smart desks.

Theoretical saturation test

Theory saturation testing is a key step in the research to confirm whether all relevant conceptual categories have been fully explored and no new information has been generated. For the study of the smart desk symbiotic experience, this method will be implemented after future interview data collection and analysis. Specifically, we plan to test the theoretical saturation of 800 randomly selected raw data from the core content on "understanding and perception of smart desk". The purpose of the test is to verify that the data continue to reflect the main categories of the analytical framework of key factors influencing users' choices of smart desks, and to check whether new conceptual categories or key relationships can be mined from the randomly selected responses. If the results of the test show that no new categories or relationships are generated from further analysis, this would indicate that the results of the theoretical coding of the smart desk symbiotic experience in the study have reached a state of saturation, implying that the data collected is sufficient to support the construction of a comprehensive theoretical framework.

3.1 Advantages and limitations

3.1.1 Advantages

"Strength One: Focus on practice and context.

We need to move from traditional scientific methods to more innovative design thinking.

Strength Two: Grounding in the Situation

Research focuses on specific questions and helps projects identify the data they need to collect.

Strength three: Embrace difference and complexity

The advantages of "starting from reality" are naturally combined with the advantages of "accepting diversity and complexity

Strength Four: Sensitizing Concepts, Analytics, and Theorizing

Design judgment is the ability to abstract subconscious insights from experience and reflection.

Strength Five: Turning to Discourse

Simply analyzing individual and collective actors is no longer sufficient for heterogeneous and integrative research in the 21st century, emphasizing the need to go beyond field notes and interview transcripts to include multiple types of discourse.

3.1.2 Limitations

Limitation One: Knowing Where and When to Create Boundaries

It's easy to get stressed out when analyzing data. Whether you are a researcher or a designer, you must find the key points among a lot of information and consider various needs when designing.

Limitation Two: Mapping Complexity

Effective layering of information that must be skillfully presented to gather in-depth data is difficult." (Uri, T. 2015)

4 Python data mining research methods

The proposed Python crawler artificial intelligence technology is used to mine text data from online user community platforms, which is mainly accomplished by the collaboration of three modules: URL manager, web page downloader and web page parser. Using this technique, we can obtain users' real evaluations of products on e-commerce platforms, which contain comprehensive user feedback on the functional requirements, emotional needs, and experience of using the products. However, most of the evaluation texts obtained by this technology are mainly expressed by users in natural language, and the text data are complex and fuzzy. In order to efficiently extract accurate and important user needs from them, the application of word frequency-inverse document rate algorithm (TF-IDF) in natural language processing technology can be used to preprocess the text data, which is a statistically based keyword extraction algorithm, which can extract the keywords in the labeled text database, and this study applies the TF-IDF to extract the information about the home smart desk and the user needs in the text of the community network evaluation, respectively. Keywords.

4.1 Advantages and limitations

4.1.1 Advantages

Strength One: Python improves data processing efficiency

Python improves data processing efficiency

Strength Two: Python improves data accuracy

Helps improve the accuracy of text data analysis, including sentiment analysis and

topic modeling.

Data preprocessing steps (e.g., stop word removal, stemming) reduce noise and improve the accuracy of analytic models.

4.1.2 Limitations

Limitation One: Big amount of data

Large amounts of computing resources, which may result in slower processing

Limitation Two: Data quality and noise

User reviews may contain a large amount of irrelevant information, spelling errors and slang

Limitation Three: diversity and change

User comments are expressed in a variety of ways and change over time

5 Methodological discussion combining grounded theory and Python data mining

Grounded theory research and Python data mining "mixed methods" research have emerged as a rapidly growing field aimed at bridging these paradigmatic divides. The integration of qualitative and quantitative methods is presented as a practical approach that can benefit from the strengths of each method while compensating for their weaknesses.

Mutual validation: the combination of methods allows for mutual validation of data and findings, enhancing the reliability and credibility of research results.

"By integrating qualitative and quantitative methods, the researcher is able to produce a more coherent and complete picture of the area under investigation than is possible with single-method research. This approach promotes a deeper understanding of the research problem by capturing numerical trends as well as underlying context and meaning." (Kelle, U. 2006)

6 Summary and future study directions for smart desk design

In the study of smart desks, both ground theory and python data research can provide unique and complementary contributions to a comprehensive understanding of smart desk usage, user experience, and their impact on productivity and employee health.

Combining qualitative and quantitative research methods, such as ground theory and python data analytics, can provide a 360-degree view of smart desks, enabling not only quantification of their effectiveness, but also a deeper understanding of users' actual experiences and needs. For example, while quantitative data may show that the use of smart desks improves work efficiency, qualitative research can further explain why this is the case, how users incorporate the use of smart desks in their daily work, and how smart desks can be further optimized to meet user needs. This multi-methodological research strategy can provide more comprehensive and in-depth guidance on the design, promotion and use of smart desks.

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