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Research on Noise Mitigation for VoC Analysis: A Study of Managers and Designers

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Abstract: *Manufacturers and service providers need new innovative tools to effectively leverage the value of Voice of Customer (VoC). These unconventional and unstructured data require specialized methods for analysis and interpretation. The current methodology primarily involves extracting keywords related to customer needs from VoC, followed by proposing corresponding management and marketing strategies. However, diverse interpretations of these keywords can result in irrelevant noise due to variations in employees' professional and working backgrounds, which could hinder decision makers' understanding of customer needs. To address this issue, this paper focused on managers and designers across functional departments as research subjects, aiming to identify relevant factors that could influence noise generation in VoC analysis work and suggest appropriate strategies for mitigating such noise.*

Keywords: VoC Analysis; Noise Mitigation; Goal System Theory; Self-Awareness of Goals Task; Designer; Manager

1. Introduction

In the digital age, businesses face a growing amount of customer data from various sources such as social media, feedback, reviews, and more. This data, known as the Voice of the Customer (VoC), provides valuable insights into product performance, customer satisfaction, and market trends. However, existing methods for analyzing this unstructured and disorganized data struggle to effectively process it. This leads to insufficient or misunderstood information extraction that can impact decision-making outcomes. The complexity in analyzing VoC data primarily arises from its diverse language and subjective expressions which make accurate and consistent information extraction difficult. Additionally, differences in staff backgrounds and experiences further exacerbate this problem. Urgent research is needed to develop new analytical tools and methods for VoC data that transcend departmental boundaries while providing integrated interpretations to reduce noise interference and improve accuracy and efficiency in analysis. These tools can also help businesses better understand and predict customer behavior for formulating effective management strategies.

Currently, the leading research in VoC analysis primarily focuses on online text processing, keyword tagging techniques, and innovation management studies. However, there is a lack of studies specifically targeting cross-functional departments in work noise analysis and bias assessment research. Instead, these studies primarily focus on specific functional staff like managers [1]. Yet, VoC analysis typically involves collaboration between cross-functional departments. In the literature of cross-functional department innovation management research, only individual factors influencing innovation efficiency are usually considered (e.g., studying language differences among departments) [2]. In previous studies, I elucidated the potential presence of noise phenomena in VoC analysis through literature review. However, experimental investigations were not conducted. Therefore, basing on prior theoretical research, this paper expands the empirical research section by employing knowledge interviews and factors identification methods to explore and substantiate VoC analysis further. Additionally, it investigates the causes of noise and proposes specific mitigation measures [3].

Specifically, the research objectives can be divided into two categories: 1) What are the reasons behind different interpretations or decision outcomes made by employees during VoC analysis? 2) How can occurrences of noise in VoC analysis be mitigated?

2. Literature review

2.1 Language Differences

Research has shown that consistent ideas have a positive impact on business outcomes [3]. Surprisingly, communication conflicts have been identified between designers and marketing departments [4], designers and engineers [2], as well as designers and managers in the literature search on new product development. These conflicts are attributed to language differences [5], indicating that there are indeed language differences present in the new product development process which cannot be ignored. Voice of Customer (VoC) analysis is a crucial part at the front-end of new product development aimed at capturing customer needs and expectations for translation into innovative products or services. However, due to these language differences, interpretation and judgment of VoC may introduce noise during communication thereby leading to conflicts that reduce efficiency in VoC analysis.

2.2 Difference between "goal" and "means"

According to Goal Systems Theory (Figure 1), an individual's intrinsic motivation stems from the cognitive association between means and end goals [6]. When goals and means are psychologically integrated, individuals possess intrinsic drive as thoughts of one naturally evoke thoughts of the other. In terms of disparities between goals and means, research on language differences in industrial design reveals that designers and managers share similarities in aesthetics, form-function relationships, consumer experience; however they differ in their comprehension of "means" and "ends" within industrial design. This study highlights that when managers communicate with designers, misunderstandings and tensions can arise due to the use of different vocabularies. As a designer, it is important for designers to acknowledge this dynamic proactively while considering how functionality can be effectively merged with market demands [7].

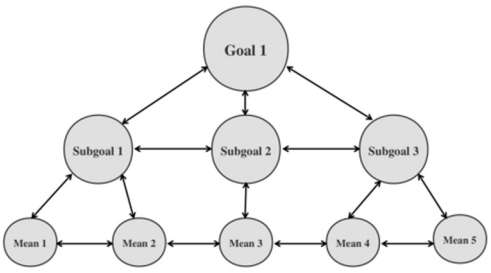

Figure 1. A system of goals and means [6]

2.3 Self-awareness

Self-awareness and goal-oriented planning drive decision-makers. Previous research has shown that self-awareness is crucial in early-stage decision-making as it enables individuals to accurately identify and actively monitor their goals while reducing differences between them. In 2023, Michela et al. conducted a study on the Self-Awareness of Goals Task (SAGT), which provided recommendations for decision-makers to Self-representation goal priority, temporal sequence, and efficacy criteria [8]. This aids decision-makers in managing memory, attention, and complex information processing. Thus, the level of self-awareness can impact participants' performance and potentially affect noise generation in VoC analysis work.

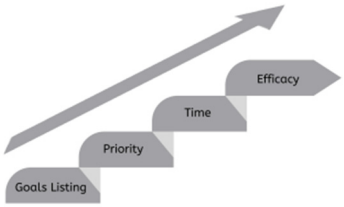

Figure 2. Self-Awareness of Goals Task (SAGT) procedure [9]

3. Materials and Methods

The purpose of this study is to identify the reasons for different interpretations or decision outcomes from the same data in VoC analysis work, and propose an adaptive noise management strategy. For this purpose, the research is divided into two parts: personnel interviews and factors identification. Personnel interviews are conducted to verify whether there is noise phenomenon in VoC analysis work through communication with personnel, as well as to determine whether the factors mentioned above are responsible for generating noise, or if there are other overlooked factors. Additionally, this study draws on Pietro Micheli et al.'s 2012 article, which explores the cognitive understanding of goals and means in industrial design across different roles [9]. Factors identification in this study is achieved through comparing textual results from participants to confirm whether language differences and differences in goals and means actually exist in VoC analysis work.

Furthermore, regarding factors related to self-awareness states, this study refers to suggestions made by Michela et al. in their Self-Awareness of Goals Task (SAGT) research, which proposes that professionals can determine their self-awareness states by observing their self-representation goals behavior [10]. Therefore, this study requires participants to express their decision goals themselves and prioritize them according to different criteria (priority, time, effectiveness). This self-expression behavior can reflect participants' level of self-awareness towards their decision goals.

3.1 Personnel interviews

3.1.1 Sample

The study chose three companies as samples based on three criteria:

1. The company specializes in VoC data analysis;
2. The company conducts VoC analysis with across function departments;
3. The company has experience with successful products.

Finally, three companies from China were chosen. China has been the world's largest online retail market for 11 consecutive years since 2013. The number of online shopping users is expected to reach 915 million by 2023 [11]. These three companies have a massive sample of VoC data. The eight managers and product designers from these companies all have experience in VoC analysis. Table 1 summarizes the samples, and due to confidentiality reasons, pseudonyms were used for the interviewed companies.

Table 1. Three companies' samples of subjects

Company Pseudonym	Company Product/Background	Subjects	Total
Design Co. Nanjing, China	• Large design company. • The company has gained a lot of project experience and won many awards in 20 years of development.	• Two product designers(a/b) • A marketing manger(a）	2D[1] 1M
Household Co. Shenzhen, China	• Smart home products. • Department with in-house design.	• An industrial designer(a)	1D 1M

Robot Co. Shanghai,China	• Most department designs are done in-house. • It emphasizes the idea of putting customers first on its website. • Intelligent interactive robot products. • The company has always focused on user feedback. • Develop products with internal and external designers.	• A product manger(a) • Two industrial designers(a/b) • A Research & Development manager(a）	2D 1M
Total			5 Designers（D） 3 Mangers（M）

[1] M：manager, D：designer. For example, the a designer of Design Co., whose code is Design Co.Da.

3.1.2 Procedure

Before starting, the interviewee is required to fill out a demographic questionnaire, including information such as age, work experience, and occupational background. Then the participants will be asked to answer questions as follows:

- whether there is noise phenomenon in interpreting the same data differently in their work;
- whether they agree that these three factors may lead to noise after considering language differences, goal and means differences, and self-awareness differences in interpretation;
- Are there any other factors that could cause noise potentially? The question is meant to evoke other thoughts from the interviewee.

The entire interview lasts for about one hour (including semi-structured questions) and typically generates three or more ideas.

3.2 Factors identification

3.2.1 Sample

The study uses consumer feedback of a ECOVACS (brand name) floor cleaning robot from the Chinese shopping website Taobao (http://www.taobao.com) as Voice of Customer (VoC) data, where feedback is categorized into positive, neutral, and negative comments with ratings ranging from 0 to 5. As shown in Figure 3. It serves as the primary channel for collecting VoC for the company with a large number of customer feedback on this website.

(a) (b)

Figure 3. Sample website. (a) ECOVACS (brand name) floor cleaning robot's Taobao sales page; (b) User after-sales message page.

3.2.2 Procedure

The first study of factors identification was conducted as a group project. Participants with the same professional background and language were asked to exchange opinions on the provided VoC data with their

partners and complete the analysis results. The second study, based on a proposal by Michela et al. in 2023, involved the Self-Awareness of Goals Task (SAGT). Participants had to prioritize, allocate time, and categorize job efficiency before starting work, which was divided into four steps:

1. Make a list of goals.
2. Prioritize the goals based on their importance.
3. Sorting the goals in the order in which they were executed in a day.
4. Sorting the goals based on individual efficacy (how much the person was able to accomplish them).

After completing these steps, the self-aware participants will resubmit their results. They can either maintain or modify their original analysis for all testing tasks, but each change in opinion will be recorded.The experimental process is shown in Figure 4.

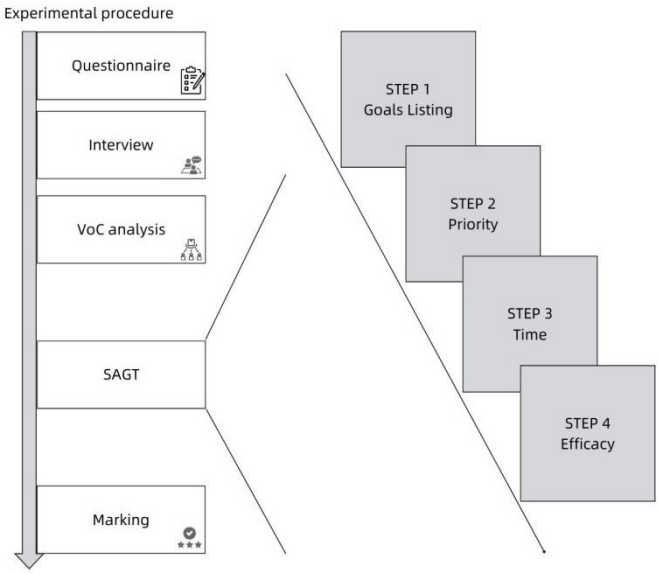

Figure 4. Experimental procedure and SAGT

4. Results

4.1 Personnel interview

In the personnel interview, consistent with previous literature research, all participants agreed on the mentioned three factors. Additionally, participants also mentioned other factors not covered in this study, including relevant work experience, gender, and company operational mechanisms. Because the proportion is small, this article will conduct identification tests on language differences, goal and method differences, and self-awareness differences.

4.2 Factors identification

First research study

The data of 8 subjects in the experimental conditions are presented in Table 2. In the first study, language usage differed between designers and managers. As shown in Table 2, the vocabulary used by designers and managers varies significantly even when addressing similar VoC issues but used different expressions. Specifically, although they addressed similar issues, they used different expressions. Managers focused on goals when presenting their findings. For example, they suggested optimizing after-sales service to enhance brand image and loyalty compared to competitors' services. On the other hand, designers emphasized specific functional issues, such as designing roller brushes more effectively to reduce users' times for after-sales support. Based on the list of requirements that participants' provided in this study, demands from the subjects were categorized into three groups: "Functionality/Usability," "User experience," and "After-sale service."

Table 2. Example Quotes for the first research study.

Vocabulary	Number of Mentions	Designers(D)	Managers(M)
Functionality /Usability	6	"Improved the design of the brush and charging functions to make sure that the basic functionalities are reliable. "(Design Co.Db) "Improving the design of the rolling brush" (Household Co.Da)	"Pay attention to the investigation of core functions and optimize processes." (RobotCo.Ma) "Product quality determines market reputation." (Design Co.Ma)
User experience	3	"Optimize the operation process to make it more convenient."(Robot Co.Db)	"Optimizing the all-round user experience from pre-sales to after-sales" (Household Co.Ma) "User experience influences brand image" (Design Co.Ma)
After sale service	7	"Optimize product design to make it easier to maintain." (Design Co.Db) "Reduce the probability of users seeking after-sales service" (Robot Co.Da)	"Improve the after-sales system to ensure comprehensive support for customers in using our products." (Household Co.Ma) "Optimize technical support and reduce the frequency of after-sales service." (Robot Co.Ma)

The second research study

In the state of self-awareness, both managers and designers modify previous results to describe customer needs more concisely and explicitly, while also adding a purpose to this practice at the end. For instance, Household Co.Da used 'improving brush design' in the first study, , whereas he changed it to 'enhancing durability through improvements in brush structure and materials' in the second study. Similarly, Robot Co.Ma described it similar with 'enhancing technical reliability of brush and charging functions.

Furthermore, due to goal setting and prioritization in advance, both designers and managers prioritize functional issues with products and after-sales service on their lists coincidentally. Additionally, new keywords such as brand image and customer loyalty were included in the second study that were not mentioned before. Table 3 presents data from 8 subjects under experimental conditions.

Table 3. Example Quotes for the second research study

Priority	Vocabulary	Designers(D)	Managers(M)
1	Functionality /Usability	"Optimize the product charging system to enhance its stability." (Design Co.Db)	"Improve the technical reliability of brush rolling and charging functions ."(RobotCo.Ma)

		"Improve the structure and materials of the rolling brush to enhance durability ."(Household Co.Da)	"enhance product testing and troubleshooting mechanisms."(RobotCo.Ma) "design a structure that is upgradable and repairable. "(RobotCo.Ma)
2	After sale service	" Simplify the process of customer feedback to enhance their post-sales experience. "(Robot Co.Da) " Adjust the user interface to improve the customer feedback process. "(Design Co.Db)	"Improve the after-sales service process to ensure timely resolution of customer issues." (Design Co.Ma)
3	User experience	"Improve customer communication experience to ensure quick resolution of after-sales issues. "(Household Co.Da)	"Ensure product lifecycle management to enhance customer satisfaction ."(Household Co.Da)
4	Brand	--	"Enhance brand image and increase customer loyalty to. "(Design Co.Ma) "strengthen the connection between users and the brand." （Design Co.Ma)

After the experiment, participants were asked to mark their own and others' performance in a questionnaire. In the previous non-self-awareness condition, two managers believed they performed better than designer participants. Four designers thought they performed worse than the subject as a manager. In contrast, most participants believed that their behavior would be similar to their partners and unaffected by positions under self-awareness conditions.

5. Discussion

These findings align with existing literature, which identifies language differences, divergent goals and means, and self-awareness as key sources of noise in VoC analysis.

First, professional background significantly influences how analysts interpret data, partially explaining the observed language differences. Individuals from similar roles tend to use consistent linguistic systems that reflect their cognitive focus—whether on end goals or implementation methods.

Second, designers often employ action- or method-oriented language, while managers use goal-driven terminology. These differing mental models around "goals" and "means" can lead to linguistic misalignment and ultimately communication breakdown, even when both parties are addressing the same customer needs.

Third, individuals with higher self-awareness are more capable of articulating their objectives clearly. In VoC analysis, this self-awareness enables professionals from diverse backgrounds to adopt a shared, goal-oriented communication style, improving mutual understanding and reducing interpretation noise. This is often facilitated by structured tasks such as setting target lists and prioritizing objectives. As illustrated in Figure 5, self-awareness serves as a moderating factor between language and goal/means misalignment.

Moreover, in performance evaluations, fostering self-awareness helps mitigate biases stemming from one's job position, promoting integrative and balanced decision-making within cross-functional teams. Nonetheless, further investigation is needed to examine how entrenched mindsets may continue to influence outcomes, even in awareness-enhanced environments.

In addition, recent advancements in natural language processing (NLP) and machine learning provide promising opportunities to enhance noise mitigation in VoC analysis. Transformer-based models like BERT and GPT can be employed to detect inconsistencies and semantic ambiguities across departments. Topic modeling techniques, such as Latent Dirichlet Allocation (LDA), can organize large volumes of customer feedback into coherent thematic clusters, reducing interpretive subjectivity. Future research could explore integrating these AI-driven tools with the self-awareness framework, thereby improving both the scalability and interpretive accuracy of VoC analysis in data-intensive organizational settings.

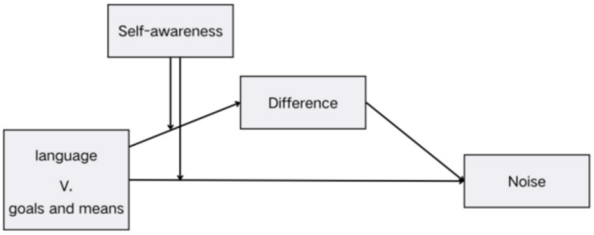

Figure 5. Noise model

6. Conclusions

In summary, this study examines information processing in cross-functional departments and discusses the factors that contribute to noise during VoC analysis work, which aligns with existing literature. The causes of noise are attributed to language differences, differences in goals and means, as well as levels of self-awareness. Two studies indicate that language differences are superficial aspects of disparities in goals and means. Self-awareness moderates the relationship between language, goals, means, and noise. Specifically, when decision-makers possess self-awareness, the discrepancies in language, goals and means diminish; team members describe their languages in a goal-oriented manner to reduce occurrences of noise phenomena.

The study is useful for employees in cross-functional department.

Advice to managers:

- Language, goals, and means vary among employees can create noise interference and mislead analysis results. All employees should understand the business content of multiple professions. Managers should consider multiple perspectives when setting decision goals.
- Communication and education within cross-functional departments should be fully implemented to integrate business processes. Effective management of goal execution time and understanding team members' effectiveness are necessary. Reasonable formulation of VoC decision lists and task priorities can reduce duplicate work and communication uncertainty.
- Managers should minimize inherent biases as analysts themselves and accept multiple viewpoints for creative decision-making.
- To enhance the applicability of these recommendations, managers can implement structured goal-alignment workshops and use decision matrices or role-specific checklists to clarify VoC interpretations.

Advice to designers:

- The development of new products requires diverse perspectives, opinions, and viewpoints. Designers in specific domains need to make appropriate compromises. Therefore, it is crucial to have a variety of perspectives in new product development. Designers should understand the project's business goals and integrate customer needs with market demands effectively.
- Language differences are not just superficial, they also include written content that summarizes customer requirements. Designers must master the ability to use accurate and concise language to express their design goals.
- Designers may adopt "VoC translation sheets" to convert raw feedback into actionable design goals. Establishing feedback loops between managers and designers early in the development process can further reduce miscommunication.

Despite the value of this study, several limitations remain. The sample size is small and geographically concentrated, consisting of only eight participants from three companies in China. This limited scope restricts

the generalization of the findings. Future research should include a broader range of participants, such as engineers, marketers, and professionals from other regions and industries. Exploring how cultural and disciplinary backgrounds influence language use, goal setting, and self-awareness could reveal additional sources of noise in VoC analysis.

In addition, the study is primarily qualitative. To enhance empirical rigor, future research should adopt quantitative methods. Structured surveys could be used to measure the frequency and severity of identified noise factors, while statistical approaches such as regression analysis or structural equation modeling (SEM) could examine how language styles, goal orientations, and self-awareness levels relate to communication effectiveness. These methods would strengthen the statistical reliability of the findings.

Future studies may also benefit from incorporating neuroscientific tools—such as electroencephalography (EEG)—to assess how varying levels of self-awareness impact decision-making under real-time conditions. Moreover, advances in data analytics and natural language processing (NLP) should be explored to improve VoC data interpretation at scale. These technologies could reduce subjectivity, improve accuracy, and support more adaptive, data-driven decision-making frameworks.

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Conflicts of Interest: The authors declare no conflict of interest.

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