HMI Design Project Construction of Car Entertainment Screen Based on Design Project Management

Zeng Xi and Zhou Zhiming[✉]

Wuhan Institute of Technology, Wuhan, Hubei 430205, China
445461695@qq.com

Abstract. According to the theoretical knowledge of design project management, this paper systematizes the HMI design process of automotive entertainment screen, and constructs the paradigm of automotive entertainment screen HMI design project. By integrating and refining the knowledge of design project management, and the factors affecting the HMI design of the car entertainment screen, this paper summarizes the architecture of the HMI design project of the car entertainment screen, and obtains the project implementation framework, so as to systematize and standardize the process of the HMI design project of the car entertainment screen, and improve the efficiency of the implementation of this type of project.

Keywords: Design management · Design project management · HMI · Car entertainment screen

1 Introduction

With the development of intelligent technology and Internet technology, the design focus of the automotive industry has shifted, and the automotive HMI, as a medium for information exchange, has become a new focus of automotive design. Good automotive HMI design can effectively convey complex information to achieve good human-computer cooperation and improve user experience. A large number of existing researches focus on the HMI design methods and design principles of the central control screen, hoping to further improve the efficiency and safety of the central control screen. Under certain circumstances, users have entertainment and office needs, and many car companies have also added entertainment screens to the design of MPV (Multi-Purpose Vehicles) or SUV (sport utility vehicles). Due to the differences of users, functions and use environment, the HMI design system of the car central control screen can not fully apply to the HMI design of the car entertainment screen, so it is necessary to study the HMI design of the entertainment screen. At present, there is no research related to the HMI design of car entertainment screen, including the research on its design process and design management; At the same time, it is an interdisciplinary field involving psychology, color science and other disciplines, with a certain degree of complexity. A good design

management scheme and project implementation architecture can make the project get twice the result with half the effort. Therefore, the HMI design project management of automotive entertainment screen is a field worthy of study.

2 HMI Design and Design Project Management of Automotive Entertainment Screen

2.1 HMI Design of Car Entertainment Screen

HMI design takes cognitive ergonomics as the design criterion and evaluation standard to design an interface that can make up for human cognitive defects and limitations [1]. It has a dual definition and can be interpreted as human machine interface or human machine interaction. In the automotive field, it refers to the "Automotive human-machine interface", including the direct and indirect automotive human-machine interface, which is the medium for information exchange between the automotive system and passengers. The goal is to improve the user's driving experience through intelligent design [2]; Interactive is a subject that studies how human and machine interact in the system [3]. Good human-computer interaction can reduce the learning cost of users, improve the operation efficiency of users, and increase the availability of products. Therefore, excellent automobile HMI design includes visual effect design and human-computer interaction design.

According to different functions, the vehicle display can be divided into the following five types (Table 1), with differentiated functions and different user groups, so the requirements and specifications of HMI design are different. The entertainment screen in the passenger seat is mainly designed for passengers' entertainment and office needs. There are relatively many forms of rear entertainment screens, mainly including three types: roof suspension, fixed behind the front seats, and front and rear barrier type. For different forms of entertainment screens, stunning interface visual effect, smooth device interaction and immersive entertainment experience are their common design core. Therefore, different from the single trend of central control HMI design, it is more reasonable to set up more teams to quickly get a variety of different effects when implementing the entertainment screen HMI design project.

Table 1. Types of automotive HMI designs

Kinds of screen	Instrument screen	central control screen
Instrument screen	driver	Provide vehicle information
Central control screen	driver	Control vehicle equipment, entertainment
Entertainment screen	Passengers	Entertainment and work
Head-up Display	driver	Assist driving
Door control screen	Passengers and driver	Control door
Rear-view screen	driver	Provide information outside the vehicle

2.2 Design Project Management

The Project Management Institute, established in 1969, defined project management as "a system management method with project as the object, through a temporary, professional and flexible organization, to plan, organize, guide and control the project efficiently, so as to realize the dynamic management of the whole process of the project and the comprehensive coordination and optimization of the project objectives" [4]. In the project life cycle, the work scope of the project should be managed, mainly in the aspects of project cost, quality, human resources, procurement and so on [5]. Design project management belongs to the functional design management at the shallower level of design management, it is a system management method with the design project as the object. By looking for suitable designers, engineers, accountants, etc., it establishes a temporary special design team to efficiently plan, organize, guide and control the design project, so as to realize the integration of the whole process of the design project, reasonably allocate the resources required for the design, and comprehensively coordinate and optimize the design project objectives [6]. The method and theoretical system of project management are also applicable to design project management, but design project management has its own characteristics and is quite different from other related activities. According to the characteristics of HMI design of car entertainment screen, the following characteristics can be extracted from the personnel organization, operation mechanism and result output of the design project:

- Multilevel. It refers to that a design project includes participants of different disciplines and levels.
- Interdependence. There are many types of personnel involved in the design project, and they must cooperate with each other to complete the project.
- Specificity. There is no identical project. When a project ends, it is impossible to encounter the identical project again.
- Phased. When one stage is completed, it can enter the next stage. Each stage has a connection.
- Repeatability. Most design projects need to repeatedly communicate with Party A's personnel in the design and optimization stage, extract key information, and iterate the design scheme.
- Targeting. The orientation of the design project to the results is very clear.
- Uncertainty. Although the design result orientation is clear, it will be affected by external factors such as the strength of materials and insufficient technology, so the design structure is uncertain. During the continuous iteration, the design results will differ greatly from the original scheme.

3 Construction of HMI Design Project for Car Entertainment Screen

3.1 Project Organization Framework

The purpose of building a design team is to complete the design tasks efficiently and orderly, and maximize the design capacity [7]. In a HMI design project of the entertainment screen, a project director or Party A's communicator will be set to coordinate

the project, and a design director and a development director will be appointed to be responsible for the coordination, organization and management of the project operation. The members of the project can be divided into three levels, as shown in Fig. 1. The framework structure can be increased according to the scale of the project.

Project directors at the leadership level or Party A often participate in the design of early-stage vehicles. They need to accurately transfer the user's needs and design requirements to the HMI design link. Therefore, they not only need to master professional design knowledge and development knowledge, but also need to coordinate with all parties to meet the preset design requirements. Their basic task is to complete the tasks of planning, organizing, providing the materials required for the design, supervising the project progress, etc., leading the whole project team to carry out the design project in an orderly manner and complete the design work efficiently.

The second level is the functional level, including at least one design director and one development director. Their responsibility is to implement the arrangement of the project director, assign tasks to the team members, and supervise the team members to complete the tasks at the same time; Report the project progress to the supervisor in time or put forward constructive suggestions to the project supervisor. HMI design project is a linear workflow, and the handover work during phase change is also important. The orderly completion of this process requires the cooperation of the department heads at the functional level.

The executive level of the design project is the actual designer, and the project team members are at this level. Each team member needs to find their own position, develop their strengths and circumvent their weaknesses, and give full play to their subjective initiative under the rule system; At the same time, improve the cooperation ability, communicate with each other, and complete the design project in a team.
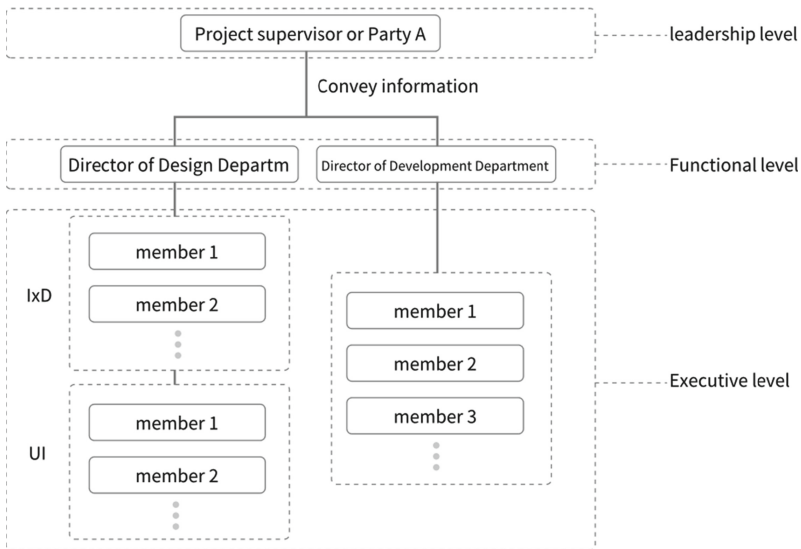
Fig. 1. Organization chart for HMI design project of entertainment screen (drawn by the author)

3.2 Preparation Phase

Before the implementation of the project, it is necessary to conduct a preliminary evaluation of the project (Fig. 2) to determine the feasibility of the design project, and then use the method of technical and economic analysis to predict and evaluate the future benefits of the project, so as to determine the feasibility of the project. The evaluation content mainly includes four aspects: (1) market evaluation, including the development trend of consumer groups, consumer income and similar products. (2) HMI loading device and development technology evaluation. (3) Evaluation of design scale. (4) Design risk assessment.

The determination of design objectives is one of the important parts of design project management. With objectives, the project can be carried out. The establishment of goals needs to start from the basic task of the project and the characteristics and pain points of the product, consider the needs of users, carry out design analysis on ergonomics and user psychology, and pay attention to flexibility while grasping consistency, so as to maximize the design power.

The success of new product development depends on two factors, one is to do the right project, the other is to do the right project. It is necessary to [8]. Therefore, it is important to do the right thing at the right stage. For a complex design system composed of multiple elements, it is necessary to build a flow chart (Fig. 3) before operation to ensure that there are traces to follow in the implementation process. In actual projects, the design process is often a dynamic process, which is easy to be interfered by external factors. Therefore, it is necessary to refine the design process, facilitate organization and supervision, and promote the transformation of design to commodities.

After confirming the design process, it is also necessary to develop a project time schedule to enable the project to advance in an orderly manner within the specified

Evaluation of the earlier stage				
Beginning		Plan		Conception
		△ Evaluation of plan	△ Evaluation of conception	
project management		Analysis of users Function framework Information framework project management	Analysis of users Function framework Information framework IxD UI project management	

Fig. 2. Evaluation of the earlier stage (drawn by the author)

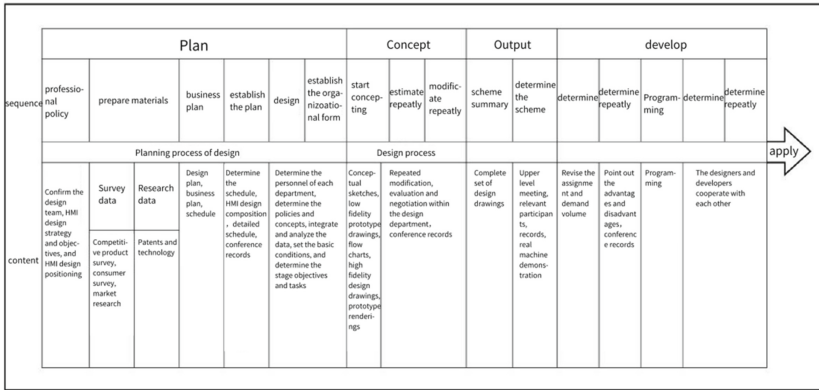|	Plan						Concept			Output		develop					
sequence	professional policy	prepare materials	business plan	establish the plan	design	establish the organizational form	start concepting	estimate repeatly	modificate repeatly	scheme summary	determine the scheme	determine	determine repeatly	Programming	determine	determine repeatly	apply
	Planning process of design						Design process										
content	Confirm the design team, HMI design strategy and objectives, and HMI design positioning	Survey data / Competitive product survey, consumer survey, market research	Research data / Patents and technology	Design plan, business plan, schedule	Determine the schedule, HMI design composition, detailed schedule, conference records	Determine the personnel of each department, determine the policies and concepts, integrate and analyze the data, set the basic conditions, and determine the stage objectives and tasks	Conceptual sketches, low fidelity prototype drawings, flow charts, high fidelity design drawings, prototype renderings	Repeated modification, evaluation and negotiation within the design department, conference records		Complete set of design drawings	Upper level meeting, relevant participants, records, real machine demonstration	Revise the assignment and demand volume	Point out the advantages and disadvantages, conference records	Programming		The designers and developers cooperate with each other	

Fig. 3. Design flow chart of automobile HMI (drawn by the author)

time, so that the project can be completed on time and improve the efficiency of the project. When formulating the time car entertainment screen HMI design schedule, it is necessary to continuously subdivide the design project, and at the same time, it is necessary to adopt a flexible strategy, leaving a certain buffer space.

3.3 Implementation Phase

The implementation stage of the project is a crucial stage of the whole project, and the results of this stage are related to the results of the project.

Stage management of design process. According to the personnel structure chart, personnel can be organized. Due to the differences between the use environment and user requirements of the car entertainment screen and the central control screen, the core of the HMI design of the car entertainment screen is the visual effect. In order to output more specific HMI design, the design process needs to be supported by a large number of conceptual designs. It is relatively reasonable to adopt the form shown in Fig. 4 for personnel organization and design evaluation in the design department. The members are divided into several groups to carry out concept design independently, hold periodic meetings, evaluate among groups, absorb their advantages and modify their disadvantages, iterate on the concept, and finally discuss and select the most suitable scheme to continue deepening.

According to the design flow chart, the design process can be divided into two main stages: the conception stage and the output scheme stage. The conception stage belongs to the stage of divergent thinking, which can be subdivided into multiple parts. A large number of brainstorming sessions are conducted in a cycle of two to three days to get a wealth of options. The supervisor regularly checks and summarizes the scheme to understand the progress of the project and ensure the quality of the design. Refer to Fig. 5 for specific implementation methods; The output scheme stage is the integration stage. This stage can be divided into two parts: scheme summary and finalization. The first part requires the rapid integration of all schemes to obtain two or three suitable proposals. The second stage requires a lot of time to polish the details.
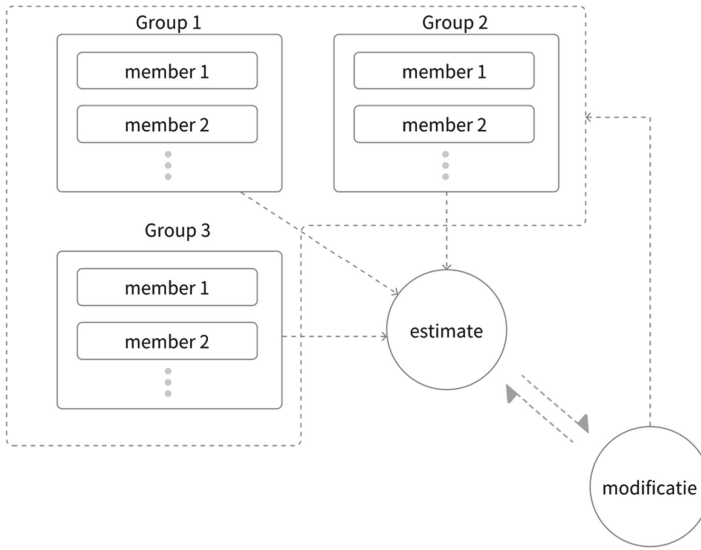
Fig. 4. Schematic diagram of group work execution (drawn by the author)
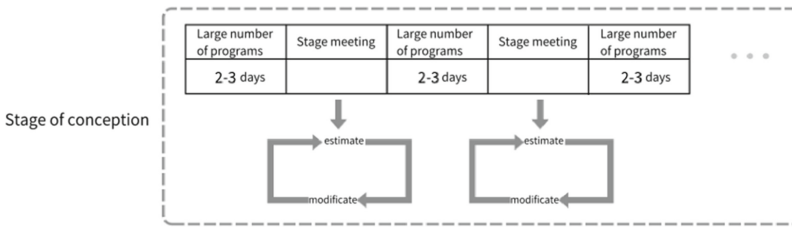
Fig. 5. Schematic diagram of conception stage (drawn by the author)

Quality management of design process. Quality is the sum of characteristics that reflect an entity's ability to meet explicit or implicit needs. It is necessary to [9]. The primary standard to determine the success of a design project is the quality of the design project. The quality management of automotive entertainment screen HMI includes three aspects: design, technology and market. Kansei Engineering, ergonomics, aesthetics and other elements belong to the scope of quality management. Based on the project, the quality chain can be built under the guidance of quality objectives to effectively control the quality of automotive HMI design projects, so as to meet the quality needs of each other.

Cost management of design process. Design cost control means that the design team strictly calculates, assesses and supervises all the costs that constitute the design cost according to the established cost objectives in the design process. The cost management of automotive HMI design mainly focuses on the management of human resources and the allocation of time. In the middle and late stages of the project, the number of schemes will drop sharply, and the focus will be on one or two schemes. However, due to the

multi-level nature of personnel and the asynchrony of personnel thinking, the main management is mainly focused on the scheme proposer. At this time, the distributed management of scheme modification tasks, the centralized management of data files and the application of advanced software are very important; In addition, due to the multi-stage and uncertainty of the project, time flexible management measures play a vital role in the quality of the project.

4 HMI Design and Implementation of Car Entertainment Screen

4.1 Establishment of Project Organization Framework

This project is a general motors entertainment screen HMI designed for automotive screen suppliers. A total of 19 members are responsible for the design part. One design director and five team leaders are responsible for multi thread and multi scheme design.

4.2 Preparation Phase

The preparation stage is mainly divided into three parts. The first is the integration and refinement of the design information. It is clear that the user group is middle-aged and wealthier, and the design style is high-tech. Then according to their own conditions, complete the preliminary evaluation, and determine that they can complete the design task. After the completion of the evaluation, the time plan of the design project is clear. The cycle is 34 days, of which the first 14 days are the conception stage, and the scheme output stage has 7 days. The remaining time is to optimize the design, and according to the confirmed effect, 24 inch and 29 inch design drafts are output.

4.3 Implementation Phase

In the implementation phase, the design director defined the information and functional architecture of the design. Five team leaders led the team members to carry out the low fidelity prototype design according to the plan, collected a large number of reference drawings, and output the home page design in five different directions. A two-day phased meeting was held. Three rounds of evaluation and modification were carried out on the five schemes simultaneously, and five relatively perfect schemes were obtained. They were submitted to higher managers of the project, and finally the author's design scheme was adopted.

After clarifying the design method and the direction of the form of expression, the team was integrated. According to the confirmed home page effect, the team members made secondary pages according to the division of labor. After the completion of the production, the team members made overall modifications and regularization for the scheme leader, constantly adjusted the design content, plate distribution, color filling, etc., and output a complete set of HMI page design effect (Fig. 6 shows the renderings of the homepage).

After the scheme was determined, we had a long-term communication with the relevant personnel of the development department to ensure that the scheme could be
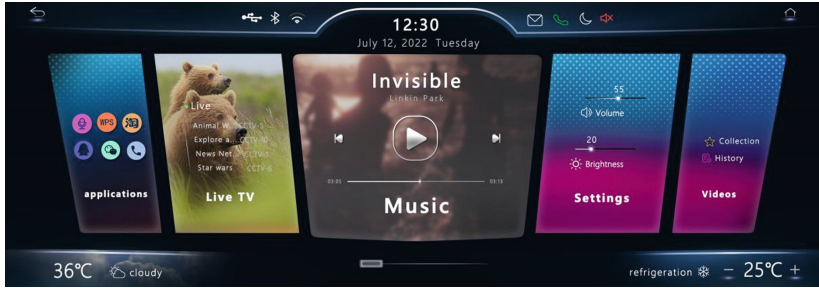
Fig. 6. Renderings of the homepage

commercialized, and constantly modified the content, color, pattern, etc. according to the technical and version requirements. After the hardware equipment was determined, we carried out a color correction on the test version of the system, and finally the developers successfully completed the development.

5   Conclusion

Under the background of globalization, intelligence and the increasing popularity of the Internet of things mode in the world, automotive HMI design stands out from the automotive design field and becomes an indispensable part of automotive design. As a special automobile HMI design, the HMI design of entertainment screen has become an important breakthrough in the future automobile design and HMI design, and has promoted the development of automobile design industry. The design project management can manage the automotive HMI design process in a systematic, standardized and institutionalized way, ensuring the success of the project. With the continuous extension of the design project management knowledge system in the field of automotive HMI design, it is believed that the corresponding management methods will continue to iterate and become a more systematic and refined system, and the design itself will be further enriched and developed. However, this study only explains the usability of the framework, but does not carry out qualitative and quantitative analysis. Further detailed analysis of the framework will be carried out in the future.

References

1. Mathilde François, François Osiurak, Alexandra Fort, Philippe Crave & Jordan Navarro (2016). Automotive HMI design and participatory user involvement: Review and perspectives, Ergonomics, DOI: https://doi.org/10.1080/00140139.2016.1188218.
2. Li Shuaishuai. Research on the Development Trend of Automotive HMI. Today's Media, 2020, 28(01):91–93.
3. Gao Han, Li Bo, Han Ting. Research on the Development Trend of Future Automotive interactive system. Packaging engineering, 2018, 39(22):22-28. DOI:https://doi.org/10.19554/j.cnki.1001-3563.2018.22.005.
4. Chen Yan. Design Project Management Studies. China Academy of Art, 2014.

5. Wu Jianjun, Ma Zhengpeng, Yang Yao. Design and Development of Project Management Information System Based on J2EE. Manufacturing automation, 2022, 44(04):9–12.
6. Xu Sijie. Implementation and Application of Design Project Management in Space Design. Shenzhen University, 2018.
7. Li Dan. Implementation and Application of Design Project Management in Cultural and Creative Product Design. Hubei University of Technology,2016.
8. COOPER Robert G. New Product Development Process Management. Liu Chongxian, Liu Yan,trans. Beijing: China Machine Press, 2003.
9. Zhang Junyuan, Hu Hongfei. Discussion on the Quality of Transportation Services and Dynamic mechanism. Journal of Wuhan Jiaotong University, 1999(04):430–433.