

Du, H, Zhao, Y and Ge, X

**Innovative Design of Traffic Equipment Based on Future Trend Prediction**

<http://researchonline.ljmu.ac.uk/id/eprint/15011/>

#### Article

**Citation** (please note it is advisable to refer to the publisher's version if you intend to cite from this work)

**Du, H, Zhao, Y and Ge, X (2020) Innovative Design of Traffic Equipment Based on Future Trend Prediction. Solid State Technology, 63 (2). pp. 1609-1618. ISSN 0038-111X**

LJMU has developed **LJMU Research Online** for users to access the research output of the University more effectively. Copyright © and Moral Rights for the papers on this site are retained by the individual authors and/or other copyright owners. Users may download and/or print one copy of any article(s) in LJMU Research Online to facilitate their private study or for non-commercial research. You may not engage in further distribution of the material or use it for any profit-making activities or any commercial gain.

The version presented here may differ from the published version or from the version of the record. Please see the repository URL above for details on accessing the published version and note that access may require a subscription.

For more information please contact [researchonline@ljmu.ac.uk](mailto:researchonline@ljmu.ac.uk)

# Innovative Design of Traffic Equipment Based on Future Trend Prediction

Haibin Du<sup>1</sup>, Yan Zhao<sup>1,\*</sup>, Xiuli Ge<sup>2,3</sup>

<sup>1</sup>College of Industrial Design, Luxun Academy of Fine Arts, Shenyang, China

<sup>2</sup>Liverpool John Moores University, Liverpool, UK

<sup>3</sup>Southampton International College, Dalian Polytechnic University, Dalian, China

\*Corresponding author: Yan Zhao

**Abstract**—Predicting the future shows the changes and development of design perspectives and design thinking. Its main function is to find opportunities to innovate current design in the process of predicting the future trend. Instead of blindly following the trend of technological development, it is better to actively participate in the design of the future. During this process, many design concepts and thoughts are employed to explore the essential signals existing in the past, current and future design trend, such as design opportunity evaluation method, socio-cultural research, political-economic-environmental evaluation, non-linear thinking, and multi-dimensional future prediction method. Finally, a series of design practices in the field of traffic equipment in the near future are completed by using the future prediction methods. It is concluded that the design procedures and methods for detecting and predicting the future have great significance for design innovation and prediction.

**Keywords**-future trend prediction method; near future design; nonlinear thinking

## I. INTRODUCTION

### A. Purpose of Future Trend Prediction

Clive van Heerden, co-founder of vHM Design Futures in London, believes that technology is developing at a great speed, however, technology comes into being at a rather slow pace and consumers only get in touch with technology at the final stage of its development. Most consumers have no idea about the slow process of the research, improvement and development of a new technology. Currently, many technologies including virtual reality, behavior recognition and analysis, flexible display, and biometric sensing have been developed for a quarter of a century and have been regarded as samples in research laboratories for several decades [1]. It is thought that design practitioners and users examine the development of technology at the same level, so the final design works are likely to lag behind to a certain extent.

Future design is a policy-making mechanism proposed by a group led by Professor Tatsuyoshi Saijo of Kochi University of Technology. He believes that future design is an attempt to solve the existing dilemma. Assuming that no one will protect the interests of future generations, the mechanism can designate modern people to play the role of future generations and let them experience the consequences that future generations will bear [2]. Then, through the simulation of the pre-determined future results, it will encourage people to actively transform the current situation and face the challenges of the future.

However, it has always been a difficult task to predict the future accurately. First of all, it needs to be clear that the purpose of detecting and predicting the future is not necessarily for the well-being of future generations. Nowadays, basic task of designers is to prepare for the future. Therefore, they are used to defining

the realization of design in the next few years or even later. Whether it is exploring the future or looking back at history, the purpose behind these design activities is to better serve the present. When designers detect and predict the design direction in a multi-dimensional hypothetical future scenario, they will have a better understanding about their future work.

### B. Enlightenment from the Research

Jack Ma, founder of Alibaba, once mentioned in his speech that the future era would not be the IT era, but the DT era (DT for Data Technology) [3]. The research discussed below is based on the development of large technology companies and it uses DT as the basis to explore new types of design products and business opportunities beyond the mainstream development ideas.

According to the research conducted by some companies that are usually driven by available technologies, these companies which are continued as existing product development directions. However, with the rapid changes of the market, the fixed design and promotion concepts often made these companies fail to achieve great innovations [4]. Figure 1 shows the comparison of the market share of the mobile phone products of Nokia, Samsung, iPhone, and Huawei (smartphone market research report released by Counterpoint Technology Market Research in 2019). From the appearance of smartphones to the popularity of more than ten years, Nokia still launched products as usual and failed to put forward creative products in an appropriate time. This is one of the main reasons for the rapid decline of the brand. Like Nokia, there are countless cases of companies that are not aware of the threat of the market. Designers can regard these examples as strong evidence to detect the value of innovation and change, so that they know how to use them when facing the changing conditions and competitive market and explore the future to make proper development plans.

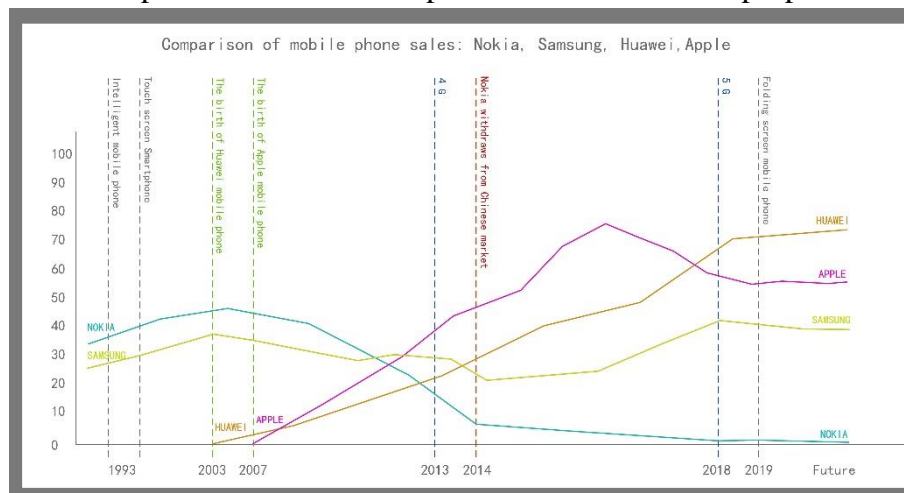


Figure 1. Market Share of Mobile Phone Products of Nokia, Samsung, iPhone and Huawei

## II. THE USE OF NONLINEAR THINKING TO LOOK FOR OPPORTUNITIES

Exploring the future is based on nonlinear thinking about the future. That is, doing away with linear thinking mode to search for more opportunities for survival and development. This method aims to identify problems and opportunities without forcing speculation based on technology or technical solutions. In order to avoid the interference of linear thinking, edge vision can be used to expand the scope of observation and find opportunities in the research and relevant fields [5].

### A. Building a Broad Vision

In the 1950s, Austrian and American psychologist Egon Brunswik used the perspective of vision as a metaphor for human's information processing and choice-making. Human being's eye pupils can capture light and the edge line of sight. Focusing one's attention is the temporary converging behavior and adjusting the

next converging point with the edge vision is a continuous activity. Brunswik believes that the process of human psychological perception is the same. The loss of a broad vision will fall into the trap of concentration [6]. Serbian performance artist, Marina Abramovic, put 1000 pages of blank paper in front of the students and allowed them to freely express their creative ideas. The students were told to put the good ones on the side of the table and the bad ones into the wastebasket under the table. After class, she first paid attention to those ideas that were thrown into the wastebasket, because they were often the ideas that students dared to think but were afraid to do. This teaching experiment also shows that marginalized ideas often imply new perspectives and creative thinking that the mainstream cannot match [7].

This also goes for design. Linear and streamlined problem-solving ideas often do not save design time and cost, however, they cause trouble through the whole process of design. Trying to build broad vision and thinking non-linearly is a multi-dimensional evaluation of design activities, which brings more possibilities for design to break through the convention (see Figure 2). When it comes to future design and technology, designers can find more speculative perspectives from the peripheral vision, and try to doubt common-sense and authoritative cognition. The appearance of AI makes people question the significance of being human beings. The gradual destruction of nature has rapidly accelerated the experiment of artificial food. The breathing and sleep systems also have to face a new normal state [8].

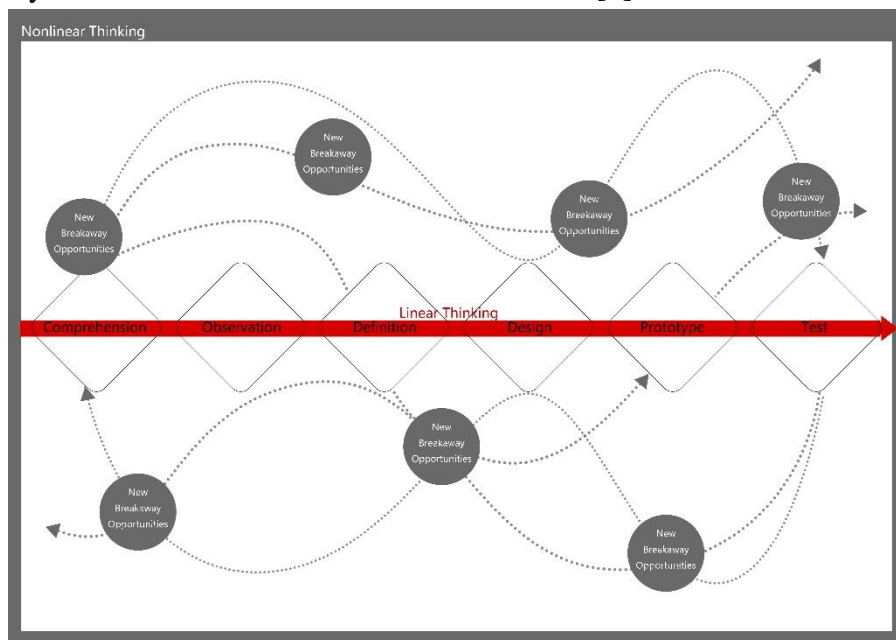


Figure 2. Linear Thinking and Nonlinear Thinking in Design

### B. Opportunity Assessment

It is not difficult to explore design opportunities in the broad design vision. This not only conforms to the natural law of human thinking, but also makes design tasks easy and enjoyable. In a design team, everyone can speak freely about the future of design opportunities. In an ideal design state, an active thinking storm will run through the entire design project cycle. However, screening and discovery are equally important for innovation. Design and creation activities always need to seek a balance between divergent thinking and convergent thinking. Therefore, the evaluation and selection of opportunities still need to establish rules and methods. Figure 3 shows two progressive opportunity evaluation methods, namely the product life cycle analysis table and the innovation degree framework diagram. The opportunity points are divided into four periods: emerging, growing, mature and declining. The design team can attribute the opportunity points to the above-mentioned four periods based on the attributes of the products within their life cycle. The evaluation of the opportunity

points has a certain vitality and growth space. Then, it brings the opportunity points with certain potential into the Innovation Mapping Framework, and predicts the creativity and influence they can bring about. Although the above evaluation results are designed for the future, they need to be supported and based on a large number of real cases and data.

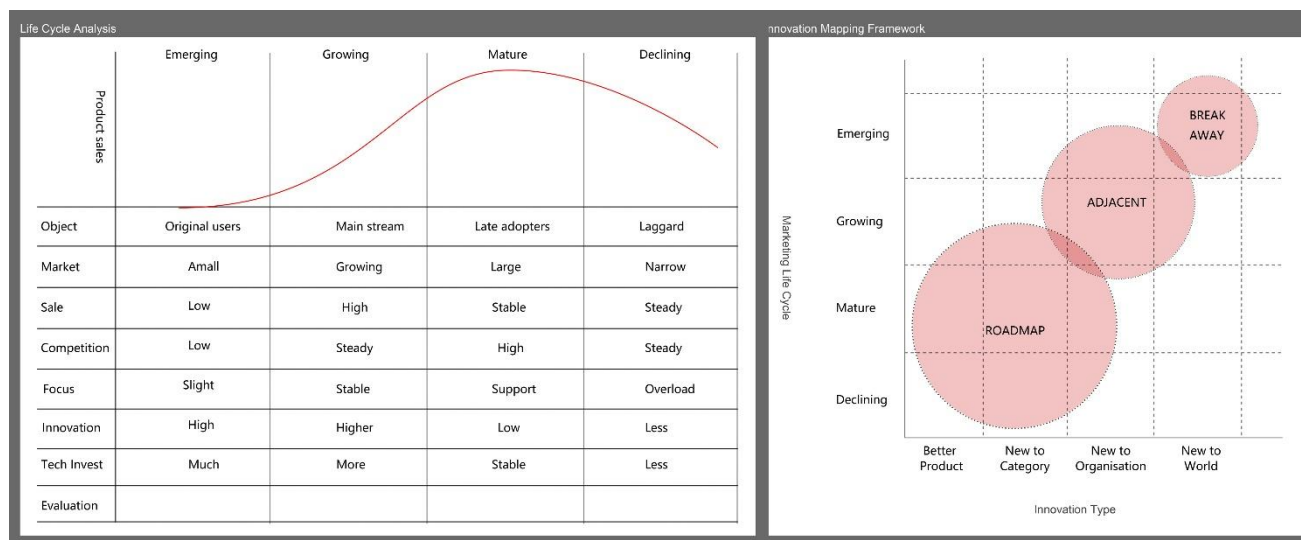


Figure 3. Product Life Cycle and Innovation Evaluation Framework

### III. EXPLORING THE USE OF FUTURE LAW

Relevant methods for detecting and predicting the future are not guided by technology. It aims to understand the trends that affect future lifestyles, changing consumption patterns, sudden behaviors, social attitudes out of the restrictions of following trends, and identify opportunities through the broad design vision (weak signal) [9]. In order to make complex detection activities clear and easy to understand, Figure 4 visualizes the process of future detection and prediction methods to clarify the purpose of each method and the relationship between the methods. It should be noted that this method is only regarded as one possibility for future exploration, but not the only one. The purpose of establishing the method is to provide inspiration for the design. However, being loyal to a certain mode will lead to the fixed mode of linear thinking.

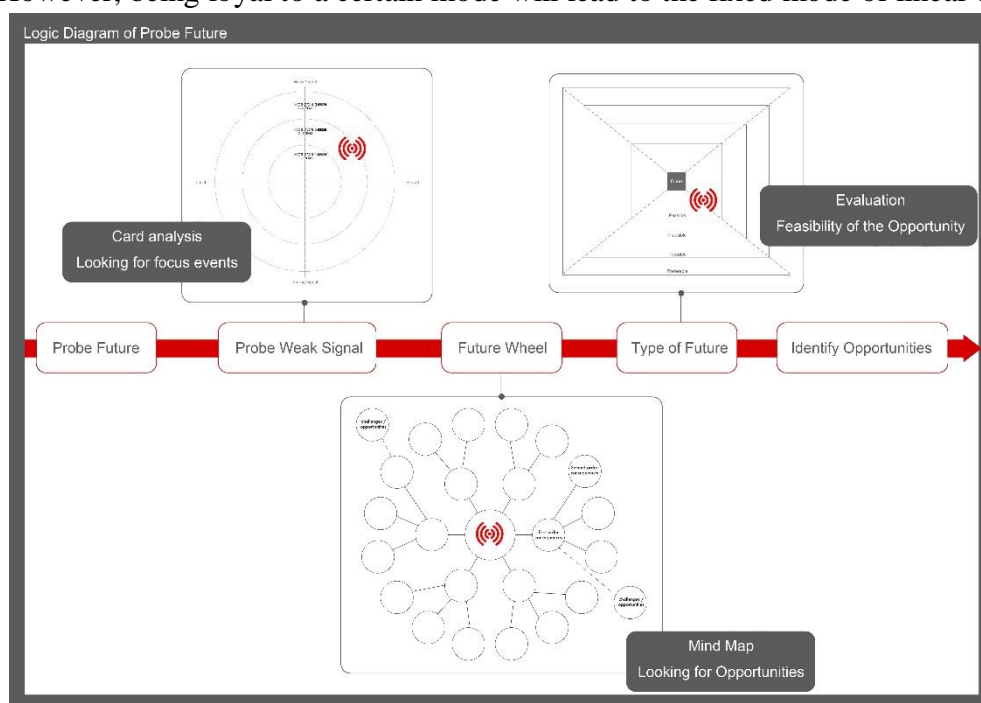


Figure 4. Flow Chart of Future Prediction Method

#### A. Probing Weak Signal

A coordinate system is established in Figure 5, where the two ends of the x-axis are local and global, indicating whether the case will occur globally or only in certain areas. The two ends of the y-axis are strong and weak signals, showing the current influence scale caused by the real cases. The three circles represent three periods, namely 1 to 3 years, 3 to 5 years, and 5 to 20 years in the future. Then, the design team uses the card classification method to find typical cases with future value based on network and field research to make several cards, and pastes the cards in the corresponding positions of the diagram. After the card classification is completed through discussion, the design team analyzes the cards in the global and weak signal areas one by one to detect opportunities that may be about to trigger the next hot storm.

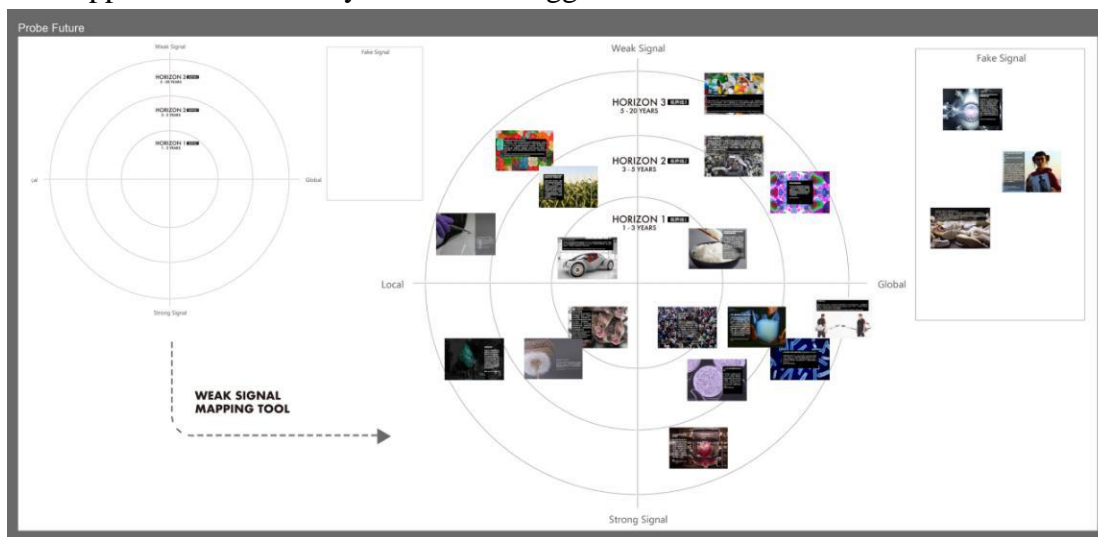


Figure 5. Coordinate Diagram of Probing Weak Signal

In the process of exploring the future, people are sure that, in contrast to continuously updated products and technologies, the demand for designers to improve the relationship between users and products has never changed, and this demand is what drives product design and innovation. It is intended to encourage the design team to participate in the future creation together to detect the weak signals in the case study, break through the influence of mainstream thinking, and think about the value implicit in the weak signals. Meanwhile, when detecting weak signals, the design team can judge the elements that can bring forth innovation so as to find the future direction of innovation.

#### B. Futures Wheel

When a weak signal is identified, it can be used as the center and origin of the design and thinking. The Futures Wheel method of Clive van Heerden is used to inspire the thinking mode. This is a mode of thinking for a design team or individuals to express their minds. In the process of synthesizing, explaining, communicating, storing and retrieving information, it stimulates design inspiration that breaks the convention. Since most people's thinking mode is rarely a linear structure, and they will not adopt simple methods that are isolated from each other when facing complex problems, the wheel of creativity can reflect the process of how the team considers complex projects [10].

As shown in Figure 6, Futures Wheel can use a weak signal as the centre, and then carry out the first round of divergent thinking of information. As the design team conducts the second, third, and even fourth rounds of thinking and discussion, they will find that this information has formed a knowledge map, and the information on the outer layer would be much closer to innovation. As a way to expand design through



information and pictures, when spreading and extending information, people involved in creativity should be encouraged to use simple single words, phrases, common symbols, icons, and hand-drawn images to form an interconnected information network [11]. These visual clues can turn Futures Wheel into a kind of auxiliary memory tool, making the design team impressed by how to obtain information and the context of the information. After the Futures Wheel is completed, the design team needs to identify the relationship between the theme (weak signal) and each part in the diagram, extract keywords, and then associate these keywords with the theme to form a new design idea.

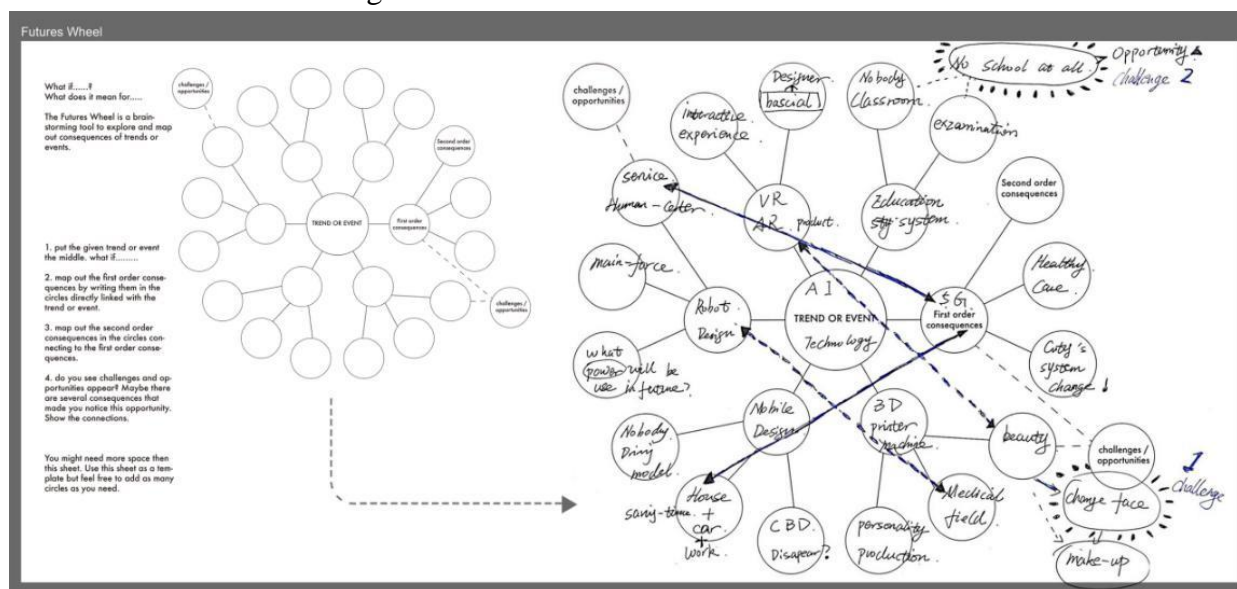


Figure 6. Mind Map of Futures Wheel

### C. Four Types of Futures

After obtaining innovative design ideas, the design team will bring them into possible future templates. As shown in Figure 7, the four futures can be used to evaluate ideas and enrich their incubation scenarios. Future detection is not like science fiction. The purpose of detecting various possible futures is to bring users expecting “better” results [12]. The futures in the picture are wrapped in layers. Among them, possible future is all the possibilities of the future; plausible future adds certain qualifications and removes some very ridiculous futures; probable future is bound to more restrictions and it is based on current technology, economy, culture, politics and many other conditions; preferable future may be what people want, or a future more suitable for human development. Exploring the future is to find a foothold in these futures, to intervene in design, and to use design practice to show a part of these future types. At the same time, as a design activity, different future types can help the team test the rationality and feasibility of the design.

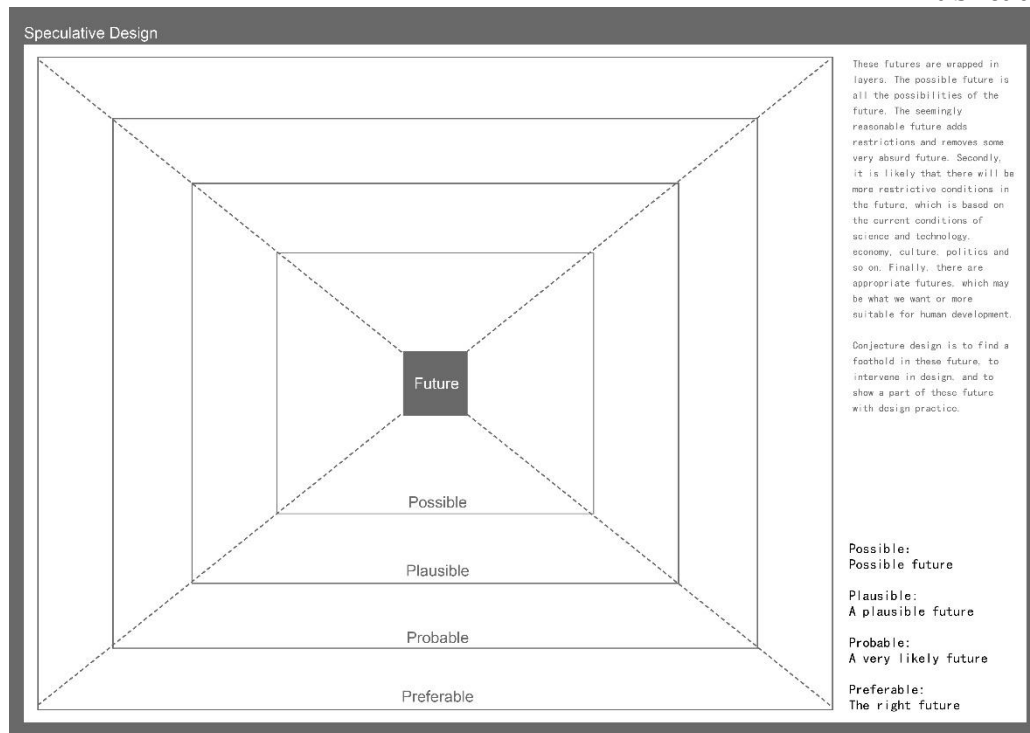


Figure 7. Four Types of Futures

#### IV. INNOVATIVE DESIGN PRACTICE OF FUTURE-ORIENTED TRAFFIC EQUIPMENT

##### A. KAMA

KAMA is designed for the local construction needs of the city. Facing the future, the mainstream thinking of the design of such engineering equipment will continue to focus on how to save space, be intelligent, and unmanned control platforms, and shift from single function to multi-function. Of course, KAMA has a very prominent innovative structure in terms of function settings, that is, automatic switching of construction tools. However, the article's evaluation of KAMA is from a single perspective to discuss the future human-machine relationship in this design. Until now, user-centered design concepts and user experience have been further deepened, and the perceptual factors in design have gradually begun to receive extensive attention and become the focus of design. Consumers' emotions and senses have also become a heated research topic [13].

KAMA's design team tried to establish new design ideas, and changed people's attitudes towards this type of urban construction machinery as design opportunities and challenges. The specific design process is to break through the mainstream development ideas of urban construction machinery, find innovative opportunities for perceptual engineering, reverse the user's boredom with the product, and establish a new urban symbiosis relationship. The designed KAMA (see Figure 8) pays attention to aesthetic elements in appearance and uses bright colors. The smart shape tries to attract people's attention and inject new vitality into the city.





Figure 8. KAMA Urban Construction Equipment. Design Team: Luxun Academy of Fine Arts

### B. Upbus

Nowadays, traffic congestion has become a practical problem facing many cities in the development of cities. The traffic situation in cities such as Beijing, Shanghai and Hangzhou is severe. The traffic jam during rush hours has become a fact that people have to get used to [14]. The solutions to future traffic problems are becoming more and more diversified. While many unconstrained ideas bring new enlightenment to people, they will also raise more questions. Upbus defined creative ideas in the Probable future, and completed a design concept. The core of this eco-friendly design is the 3R principle, namely “Reduce, Reuse, Recycle” [15]. As shown in Figure 9, Upbus maintains the original road structure and innovates at the lowest cost to change the traffic congestion problem. The car body of this kind of light rail can be raised, and it can travel on top of other vehicles. Passengers can get on and off by a deformable hydraulic elevator. The electrical system and operating system can adopt the general technology of the current light rail.

Using design methods that explore the future, the Upbus design team tried to get rid of the constraints of conventional and mainstream transportation development thinking. At the same time, this design introduced the concept of eco-friendly design, and then made some innovations without changing the original facilities. Finally, it adopted a way to create structural innovations. In addition, in terms of appearance design and human-computer interaction design, Upbus tried to provide urban citizens and travelers with a comfortable travelling experience.



Figure 9. Upbus Urban Concept Light Rail. Design Team: Luxun Academy of Fine Arts

## V. CONCLUSION

Exploring the future is essentially a process of studying history, and those future events that affect our way of life can usually be seen as trajectories left by the present and the past. People tend to look at historical events in isolation, but each event will show a chain reaction, like the ripples of pebbles thrown into a pond [16]. For design, the clues of innovation can be detected from different situations in the past, present, and future. However, the perspective and goal of design must be oriented to the future. Therefore, the new technology, new materials, and new trends that designers always pay attention to may play a role in the next few years or even in the near future. It can create a more ideal, efficient, comfortable, and humanized life and environment for humans through design. Then, exploring the future-related thinking methods has a significant value. Placing the exploration of the future in the current environment can also inspire innovation and development in various fields of current design in various ways.

## ACKNOWLEDGMENT

This article is sponsored by Luxun Academy of Fine Arts (Project type: Serving local economic construction). Project: Major Landmark Achievement of the First-class Discipline in 2018: Design of Traffic Equipment. Project No.: Design. No.10. 2017

## REFERENCES

- [1] N. Zhang and S. Shao, "Analysis of the development trend of future design," in *Popular Literature*, vol. 12, 2020, pp. 57-58.
- [2] L. Hay, P. Cash, and S. McKilligan, "The future of design cognition analysis," in *Design Science*, vol. 9, 2020, pp. 20-21.
- [3] L. Han, Y. Wang, X. He, and C. Wang. "Design and research of mobility tools based on the future," in *Science and Technology Innovation*, vol. 20, no.7, 2020, pp. 162-163.
- [4] H. Zhao and Z. Zhou, "Design based on the future --- Fu Jiong and his design trend research," in *Decoration*, vol. 4, 2019, pp. 74-75.
- [5] S. Xiao, "The development trend of future automotive design concepts and materials," in *World Metal Herald-Central Level*, vol. 6, 2020.
- [6] S. Klaus, *The Fourth Industrial Revolution*. Beijing: CITIC press, 2016.
- [7] X. Cai, "Development and design of future aircraft based on virtual simulation research," in *Educational Art*, vol. 6, 2020, p.37.
- [8] R. He, "The future of design," in *Design*, vol. 2, 2019, pp. 6-7.
- [9] Y. Liang, "The future development trend of design," in *Yihai*, vol. 4, 2020, pp. 70-71.
- [10] D. A. Norman, *The Design of Future Things*. Basic Books, 2009.
- [11] Y. Zhao, F. B. Guo and H. Du, "Creative design of virtual product in near future," in *Design*, vol. 9, 2020, pp. 106-108.
- [12] F. Zhao, Q. Zhang, and X. Sun, "Educational research on innovation and entrepreneurship of industrial design major in colleges and universities in the new era," in *Art Work*, vol. 3, 2019, pp. 112-113.
- [13] Y. Zhao, "Design is a forward-looking future for the public," in *Art and Design*, vol. 2, 2020, pp. 122-125.
- [14] T. Toruya, *User Experience and Usability Test*. Beijing: Posts and Telecommunications Press, 2015.
- [15] W. Ren Wenlei, "The latest technology of industrial design and future market research," in *Popular Literature*, vol. 4, 2020, pp. 36-37.

- [16] C. Liao and W. Zeng, "The design and practice of the future-oriented values education curriculum system --- A review of the Australian values education curriculum," in Basic Education, vol. 6, 2019, pp. 73-81.