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Improvement and Application of the Kano Model for Product Planning

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Abstract:

When user research results are applied to the product planning of an enterprise, user needs sometimes lack hierarchies or constraints. Consequently, user research data are lost and product planning is conducted blindly and randomly, leading it to be unable to provide effective support for problems related to decision-making. Based on the Kano model, we proposed an improved model for user needs, technical feasibility, and business viability (UTB model)that could effectively use data about user needs to provide support for decision-making in product planning. We combined the hierarchy of user needs in the Kano model with two constraints, namely business viability and technical feasibility, to distinguish among the nine major cells of the product graph, from which the short-term, mid-term, and long-term product plans can be made. Subsequently, we employed studies on user needs for a household gas water heater as an example to verify the feasibility and applicability of product planning.

Keywords:

User Needs, Kano Model, Product Innovation, Product Planning

1. Kano Model Analysis Method and Related Expansion Research

1.1. Kano Model analysis method

The Kano model was developed by Noriaki Kano (1984) to describe the relationship between product development and consumer satisfaction. By analyzing the relationship between the objective characteristics of products or services and the consumer's subjective perception of satisfaction, this model identifies the key factors influencing user satisfaction [6]. The Kano model separates the product and service quality factors into five categories: must-be quality (M), one-dimensional quality (O), attractive quality (A), indifferent quality (I), and reverse quality (R).

"M" refers to the functions and characteristics that the user thinks the product or service should possess. Only when these requirements are satisfied will the product or service be considered qualified and will the consumer not feel dissatisfied. "O" refers to the attributes that the user hopes that the product or service offers. When these

expectations are fulfilled, consumer satisfaction increases, and when unfulfilled, consumer satisfaction decreases. A linear relationship is generally observed between fulfilment and satisfaction. “A” often refers to the user’s latent need. User satisfaction level will not decrease when this need remains unfulfilled. Whether this factor is satisfied represents the market competitiveness of an enterprise. Therefore, enterprises should focus on increasing their number of attractive qualities to surpass competitors. “I” denotes attributes that exhibit no correlation with user satisfaction level, and “R” refers to functions or characteristics that the user rejects.

Figure 1.*Kano model of customer satisfaction (Kano, 1984).*

1.2. Research and limitations of the Kano model

Studies have generally used the conventional Kano model for classifying user needs, analysing the relationship between user satisfaction and product quality element hierarchy, and identifying the nonlinear relationships between certain quality elements and user satisfaction to provide references for product design. For example, Luor et al. [8]used the Kano model as a basis for determining which functions in a smart home were more attractive to consumers. W. W. Feng et al. [4] used the Kano model to identify user needs for exercise bikes and improved product design. Q. Feng et al. [3] used the Kano model to conduct analysis on user needs and thereby improve the design of emergency response vehicles.

However, various designs and implementations have proven that the Kano model is limited in three major respects:

(1) Vagueness and uncertainty: The Kano model is essentially used for conducting qualitative analysis. When researchers obtain user data, various uncertainties can be attributed to complex user mentality.

(2) Dynamic changes: User needs change over time. What is considered a one-dimensional quality or an attractive quality in the past may become a must-be quality in the present. However, few empirical studies have been conducted on the process of this transformation.

(3) Vagueness in decisions: Because the Kano model only outputs the hierarchy of user needs, the suggestions it offers to enterprises are vague regarding whether each attribute should be must-be quality, one-dimensional quality, or attractive quality. In other words, the hierarchy of needs does not have constraints, and this substantially restricts the amount of support it can offer in terms of the decision-making processes for product innovation and service management.

Scholars have investigated expansion of the Kano model to overcome these limitations. For example, Lee [7] integrated fuzzy logic into the Kano model, adopting a fuzzy questionnaire to reduce the subjectivity caused by the fact that the Kano two-dimensional questionnaire cannot objectively analyse complex user mentality, thereby rendering the Kano model classification more objective. Raharjo [5]proposed using the exponential smoothing method to study the dynamic change in quality elements. His optimised Kano model reinforced the effect of the Six Sigma in transaction and service industries.

Studies expanding the Kano model can be classified into the following two major categories:

(1) Those integrating the Kano model with other models, such as the Quality Function Deployment, TRIZ, SERVQUAL, failure modes and effects analysis, and Six Sigma.

(2) Those integrating the Kano model with mathematical or engineering methods, such as the Analytic Hierarchy Process, Artificial Neural Network, fuzzy logic, and Taguchi methods.

By organising studies on the expansion and application of the Kano model, we discovered that theoretical studies on the objectification and dynamic change of the Kano model have been more comprehensive. By contrast, insufficient research had been conducted to resolve the vagueness of the decision-making process in the Kano model, specifically under the premise of output product planning. Therefore, this study used product planning for enterprises as the premise. When we applied the results from Kano user research to conduct the product planning of an enterprise, we integrated multidimensional constraints and conducted an intuitive expression for the relationships between hierarchical needs and between constraints.

2. Expansion Studies on the Kano Model Based on Product Planning

2.1. Introducing multidimensional constraints

User research is the point of departure for enterprises to create innovative designs. User research should not be limited to enterprises improving their existing products and services or producing innovative products. Internally, the results can enrich internal product planning, and externally, they can disturb the market and establish the enterprise as a market leader. Therefore, the composition of the core of innovation should be determined to more effectively utilise the results of user research.

The classification of creativity is diverse. The term “innovation” has been amended by Tidd [10] and Abernathy and Clark [1] on the basis of the theory proposed by Schumpeter [9] and is separated into four major categories: architectural innovation, market niche innovation, regular innovation, and revolutionary innovation. Architectural innovation defines the basic framework of a product and process and establishes timelines for subsequent technology development and marketing. Market niche innovation refers to using existing technology as well as production and technological systems to expand new market opportunities and maintain and strengthen product design. Regular innovation is based on existing technology and production capability and is applicable to the current market and clients; moreover, it can strengthen current technology and resources. Revolutionary innovation refers to breakthroughs in existing technology and production capabilities and the launching of new products and services that suit the current market and clients. Definitions for

degrees of innovation are also diverse. Von Stamm [11]proposed the following integration of degrees and types of innovation (Figure 2).

	Product	Service	Process	Business model
Transformation	Cars instead of horses	Internet banking	Pilkington's floating glass	Internet
Radical	Hydrogen powered cars	A new kind of mortgage	Gas-filled thermo glass panes	Online sales and distribution of computers
Incremental	New car model	Different mortgage feature	Differently coloured glass	Selling in business parks instead of town centres

Figure 2. *Levels and categories of innovation (Von Stamm. 2003).*

Source: Stamm, B.V. Managing Innovation, Design and Creativity [M]. England: John Wiley & Sons Ltd.,2003:6 (translated by the author).

Radical innovation and architectural innovation are often stimulated by creativity, new materials, and new technologies, whereas incremental innovation and low innovation are often shaped by modifications to existing designs. Radical innovations are often a highly effective development strategy for newcomers to an industry. Incremental innovation explains the constant reiteration of products or services and the continual increase in market share based on the concrete market strategy of an enterprise. Therefore, innovation is usually generated from changes in user needs, in technology, or in market strategies.

The aforementioned perspectives have been verified in the design ideas of IDEO, which are human-oriented. By always putting the user first, IDEO designs understand the feelings of users and carefully observe their behaviours to identify their hidden needs and desires. Brown [2] proposed that design thinking is an innovative method that is human-centred and can be used for innovation in areas beyond products. All innovation, regardless of its type, comes from the optimal integration of three aspects: user desirability, business viability, and technical feasibility (Figure 3). From a review of the aforementioned studies, this study introduces two constraints: market and technology.

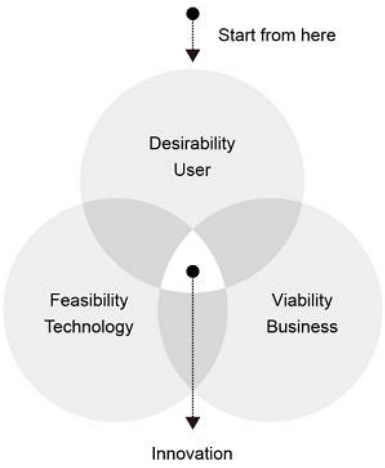

Figure 3. *IDEO design thinking tools (base on Brown, T.2009).*

2.2. Improving the Kano model

The Kano model is used as a tool for classifying user needs. The analysis results were derived solely from the single dimension of user needs. The present study introduces two constraints, namely market and technology, and performs analyses from three perspectives (i.e., user needs, technical feasibility, and business viability). As displayed in Table 2, the y-axis is classified according to the degree of innovation defined by Von Stamm [11], and the x-axis is user, market, and technology. Generally, to satisfy user basic needs, existing products or services are reexamined to maintain, strengthen, or improve them to meet the market standard by providing the functions and characteristics expected by the user. To satisfy performance needs, existing technology or production ability is used as the basis for incremental or radical improvement to achieve product extensions or innovation for improving levels of consumer satisfaction and thereby achieving an increase in market share or market impact. To satisfy excitement needs, long-term technical research and development are required to improve existing technology and create a fundamentally innovative product to revolutionise the market. User drive belongs to an offensive strategy that requires an enterprise to see through user needs and conduct effective management. The market drive belongs to the defensive strategy. The technology drive belongs to the core strategy that requires long-term input from the enterprise. Integrating the three to construct a scientific innovative drive can effectively introduce suggestions and directions to product innovative development and product planning for an enterprise.

Table 1. *Three-dimensional constraints of the user, market, and technology.*

	User **user needs**	**Market** **business viability**	**Technology** **technical feasibility**
Revolutionary Innovation	Excitement Needs	Revolutionise the market Opening up new markets through revolutionary innovation	Long-term technical research and development are required to improve existing technology
Regular Innovation	Performance Needs	Roiling the markets Seize the existing market from market leaders through continuous innovation	Enhance existing technology and manufacturing capabilities
Market Niche Innovation	Basic Needs	Maintain or follow the market	Maintain and enhance product design with existing technology, manufacturing and technology systems to meet the market standard

In brief, to intuitively present the relationships between hierarchical needs and between constraints to enable enterprises to be more comprehensive regarding the decision-making process for product planning, we produced an improved Kano model, namely the UTB model, that connects the conventional Kano model with the dimensions of market and technology. The y-axis distinguishes user basic needs, performance needs, and excitement needs according to user satisfaction levels (Figure 4). The concern for technology was approached from the perspectives of feasibility and development cost. The first level of the hierarchy is the execution of short-term improvement: market follow-up, improvement details, and neglected problems that could have been resolved. The second level is to satisfy differentiated competitive experience point and to research problems that can technically be resolved: not many concerns about internal problems of an industry. The third level is technological breakthrough and research and development to satisfy latent user needs (i.e.,

technological research and development as well as future trends): latent user needs and functional problems that cannot be satisfied now but do not influence usage. The market was divided into three levels of the hierarchy from three perspectives (i.e., enterprise business strategies, market viability, and maturity). Consumer appliances, for example, are mainly sold in three series: low-end but hot-selling, mid-end profitability and high-end flagship products.

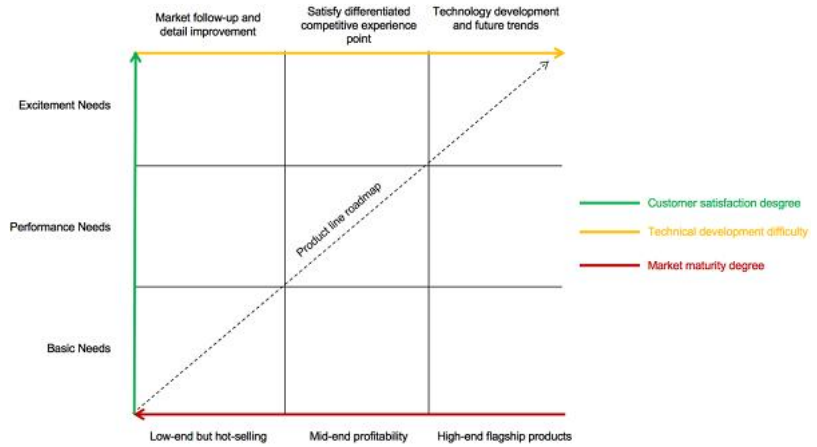

Figure 4. *Improved Kano Model: the UTB model.*

3. Empirical Case Study

Product planning for a household gas water heater of a Chinese brand was used as an example for demonstrating that UTB model can be used to export user research results and effectively transform to product line planning. This plan can guide the design, development, advertising, and promotion of new products. The preliminary research was divided into five stages (Figure 5):

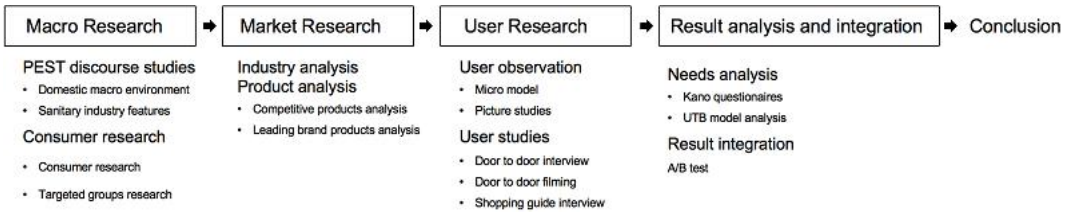

Figure 5. *Research planning.*

Macro analysis: Conducting political, economic, socio-cultural, and technological (PEST) discourse studies to analyse domestic policies, the economy, society, technology, culture, design, industry, and consumer groups as well as propose industry-related keywords as the core research direction.

Market research: Comparing the characteristics of products from leading brands in the industry with those of case products.

User research: Using the core direction derived from the macro trend to compose user questionnaires, and combining questionnaires with qualitative research, such as household observation, to identify user pain points.

Actual need analysis: Integrating macro trend, market competition research, and user research to identify major problem points, and using Kano questionnaires to evaluate the significance of factors that influence user needs and product quality.

Results integration: Propose methods for resolving user pain points. Integrating market and technology and using the UTB model to output product plans.

3.1. Obtaining user need factors

By integrating macro trend, user research, and market competition research, we derived seven major categories of user problems: safety, water temperature, water quality, noise, human–machine operation, smart operation, and appearance and installation. The problems and corresponding innovative solutions are presented in Table 2. For example, regarding water quality, the preliminary study revealed that users who did not install water purifiers found limescale accumulated in their showerhead and that sometimes water came out yellow. Some users reported itchy skin after showering. However, to install a water purifier, they were required to uninstall and replace the filter every 3 months, which was costly. After identifying the user need for removing limescale and purifying water, we proposed solutions that integrated solution plans already on the market. For example, water could be quickly purified by adding external water purification modules, such as inlet water filtration, anaerobic antibacterial water tank and magnetized water purification modules, or installing an internal water softening function that could serve the entire family.

Table 2. *Comparison of the major functions and technologies of existing gas hot water heaters.*

	user's main needs		**Brand A**
Safety	Over long electric wires and sundries may lead safety problems Users worry about carbon monoxide poisoning Untidy water tubes may lead safety problems	Anti leakage Anti fire Organized installation	Patented carbon monoxide"safety system Multi protections Upper horizontal frequency conversion fan
Water temperature	Unstable water pressure leading unstable water temperature Water temperature blow hot and cold Long waiting time due to the long tube	Instant heat constant temperature control No cold water	Intelligent High Wind Pressure resistance System no cold water Intelligent dual-broadband constant temperature system Patented Single Tube Cruise Instant Heat System Ultra-low water pressure start-up Separate High Temperature Detection Low Pressure Combustion System Blue Flame High Efficiency Combustion Technology Water and gas dual control
Water quality	Limescale accumulated in the shower head	Remove limescale Better water quality	Inlet water filtration system
Noise	Too loud when light up the fire Too noisy since it is inside the room	Reduce noise	Patented smart ultra silent system silent instant engine
Operation	Not enough temperature grades stall	Clear display convenient operation	ITO Sliding Control Touch Adjustment Technology

	Too small to read,poor display Inconvenient installation place		Multipoint Control Technology Wire controlled display
Smart operation	Users' water heaters lack of smart operation, mainly simple manual operation mode	Silent Simple Effective	One touch cruise control system Time setting cruise control system All time setting cruise control system
Appearance/ others	All the indoor water heaters require hole for air bleed The air breed pipe places on fuel pipes, not enough long Electric wires are untidy and unsightly invisible installation , avoid water heaters exposed outside Cover board useless	No exhaust need invisible tube	Patented For business use stainless steel heat exchanger Condensation Energy Saving Technology Intelligent Gas Saving Technology 100m equivalent length water recycle route
	Brand B	**Brand C**	**Brand D**
Safety	Over carbon monoxide preventive device, pre-prevention, no need to alarm Emergency call notification 60 minutes continuous combustion shutdown protection 48 degree safety lock function to prevent scald Child lock protection	CO Security Alarm Technology 360 Degree Safety Protection 6 major protection	Smart oxygen Water
Water temperature	Hot water come out without waiting Waterproof grade IPX6,water-resistant design Strengthen the anti-freezing grade,can resist-25 C severe winter Temperature rise of water shutdown I degree Rinnai 3C Thermostatic System Two core Nucleus Condensation Technology,Super First-Class Energy Efficiency Seamless Switching Combustion Technology Constant Temperature Technology of Bypass Mixed Water	3.0T No cold water technology Intelligent Frequency Conversion Constant Temperature Ultra-low Voltage Start-up Technology Adaptive thermostat system Infinite thermostat Dual Frequency Conversion Strong Drum Combustion Technology 35-65 Degree Broadband Constant Temperature Temperature sensor	Al Smart constant temperature control One-button "Full-automatic" mode Water-air two direction adjustment personalized washing

Water quality	Inlet water filtration system	anaerobic antibacterial water tank	Water magnetization technology
Noise	Low sound burning technology Silent fan,silencing bottom board	Sinusoidal noise reduction	Ultra silent
Operation	TFT Liquid crystal display Wi-Fi smart search Infrared sensor display screen	TFT Liquid crystal display App remote control	ITO Sliding Control Touch Adjustment Technology APP remote control
Smart operation	manual/automatic 24 hours reservation mode Kitchen&shower&low temperature mode ECO energy saving mode	Point cruise control mode Timing cruise control mode Single cruise control mode	Al Smart constant temperature control Energy Usage look up
Appearance/ others	Balanced design,better wind resistance,unlimited installation of high-rise buildings Installed on outdoor working balcony Marine grade oxygen-free copper heat exchanger Fully imported DC variable frequency circulating pump	Display Style of Auto LED Instrument First class energy-saving condensation technology Intelligent memory Intelligent LED	Personalized

Subsequently, we conducted assessments on factors for user needs regarding each major user problem using a Kano questionnaire with regular and reverse items. We provided participants with five options: like it very much, taken for granted, indifferent, tolerable, and strongly dislike (Table 3).

Table 3 *Kano questionnaire (excerpt).*

Like it very much: Function that satisfy you Taken for granted: A must have basic funtion Indifferent: You don't like it, but acceptable Tolerable: You don't like it, but acceptable Strongly dislike: You strongly don't like it							
Saftey			Like it very much	Taken for granted	Indifferent	Tolerable	Strongly dislike
	If adding gas detection function, how do you evaluate it?	Yes					
		No					
Operation			Like it very much	Taken for granted	Indifferent	Tolerable	Strongly dislike
	If the water heater has remote control function, how do you	Yes					
		No					

	rate it?						
Alert			Like it very much	Taken for granted	Indifferent	Tolerable	Strongly dislike
	If adding the smart alert function such as water temperature and bath time, how do you evaluate it?	Yes					
		No					
Temperature control			Like it very much	Taken for granted	Indifferent	Tolerable	Strongly dislike
	How do you evaluate smart temperature adjustment function?	Yes					
		No					
Water quality			Like it very much	Taken for granted	Indifferent	Tolerable	Strongly dislike
	How do you evaluate if adding the function of magnetized pre-purified water.	Yes					
		No					
For special people			Like it very much	Taken for granted	Indifferent	Tolerable	Strongly dislike
	If the water heater increases the child's anti-scald design, how do you evaluate it?	Yes					
		No					

The Kano evaluation (Table 4) was used for the assessment. We calculated the percentages for each type of need to clarify their distinctions. Those with a high percentage were considered major needs. For example, statistics suggest that 63% of users take for granted the function of magnetized pre-purified water, with their responses to reverse items revealing that they disliked not having this function. We could therefore classify water magnetization and purification as a performance requirements. The statistical results are listed in Table 5.

Table 4. *Kano questionnaire survey analysis.*

Product functions		Reverse question				
		Takenfor granted	**Like it very much**	**Indifferent**	**Tolerable**	**Strongly Dislike**
Forward question	Taken for granted	Q	A	A	A	O
	Like it very much	R	I	I	I	M
	Indifferent	R	I	I	I	M
	Tolerable	R	I	I	I	M
	Strongly dislike	R	R	R	R	Q

Table 5. *Kano model statistical results (excerpt).*

Evaluation standard	**People/piece**					
	M	A	I	O	R	Q
Magnetized water	17	13	7	63	0	0

To precisely identify types of user needs, our survey was administered to users in the form of e-questionnaires and comprehensive in-person interviews. To reduce the influence of participant subjective judgements and varying mentality, we selected representative users and interviewed them in depth based on Kano questionnaire items to identify the primary reasons for their answers; in addition, invalid questionnaires were removed.

3.2. Analysis of user need characteristics

We used the UTB model to integrate innovation into the product output based on the hierarchy of user needs with technical feasibility and business viability. Basic needs, performance needs, and excitement needs correspond with being able to follow industry market trends to make small short-term improvements, obtain competitive technological advantages within 1–2 years, and make long-term investments in technology research and development, respectively. For example, studies concerning smart operation have revealed that the average number of people in a household in China is five. If each family member has a different preference for shower water temperature, then the temperature setting of the water heater must be readjusted each time any family member showers. Therefore, we proposed direct and reverse items for evaluating the following factor for user needs: “How do you evaluate smart temperature adjustment?” Using the Kano model, we discovered that smart temperature adjustment belongs to consumers’ excitement needs. In other words, it is a product function that excites the user. If provided, it will substantially increase user satisfaction, but if not provided, it will not reduce user satisfaction. This study proposes the innovative solution of a fingerprint identification function for this need. Each family member stores their fingerprints in the switch button corresponding to the water temperature they adjusted and a unique colour. In its consideration of product market strategy and the development of integrated technological functions, this innovative direction constitutes a competitive technological advantage that can be realised in the short term. However, for the purpose of market acceptability, this solution should be incorporated into future 1–2-year product plans (Figure 6).

Figure 6. *UTB model analysis results.*

Therefore, we provide the following suggestions regarding this brand of household gas hot water heater:

In the short term, the low-end but hot-selling product line must adjust to market demand and offer improvements with respect to fireproofing ability, electricity leakage prevention, heating speed, and noise reduction. This can be accomplished by designing wind-powered or electric mechanisms or soundproof masks in the burning compartment and adding gaskets to prevent resonance or serve as a smoke tube buffer. Furthermore, for mid-end models, water pressure problems occurring at the peak and off-peak periods of water consumption must be resolved. For example, the automatic pressure adjustment function could ensure water pressure equilibrium, thereby increasing user satisfaction. During the same period, high-end flagship products with water purification function could be designed, which would be conducive to improving brand image and user satisfaction. However, not offering this function would not reduce user satisfaction (Figure 7).

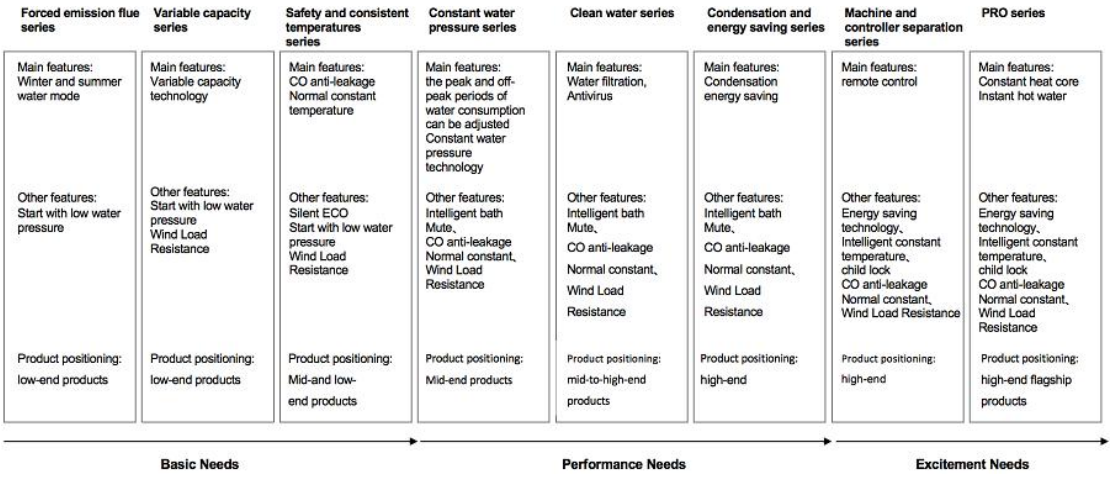

Figure 7. *Production line planning.*

The major mid-to-short term user performance needs were the integration of product and the environment. Therefore, the mid-end profitable product line must hide parts such as smoke pipes, and create an integral appearance. Furthermore, new materials could be used to facilitate the merging of product and environment. Functions such as smart temperature adjustment can be major investment points for

technological development in the mid-to-long term for establishing high-end flagship product line and innovative directions for achieving user satisfaction.

In the mid-to-long term, the major innovative direction and key to increasing user satisfaction resides in multifunctional water use, smart shower accessory components, and suitable healthy shower assessment.

4. Conclusions

In this study, expansion research was conducted to resolve the following problem: during the application of the conventional Kano model and the output of the results of user research, user needs lack hierarchies and constraints, and accordingly, user research data are lost and product planning is conducted blindly and randomly, leading it to be unable to provide effective support for problems related to decision-making. We designed the UTB model, which is an expansion model of the Kano model. By introducing multidimensional constraints, we integrated user needs, technical feasibility, and business viability to intuitively express the relationships between dimensions of needs and constraints. We used the product planning of a certain brand of household gas water heater as a case study for empirical validation and succeeded in providing clear guidance for their short-term, mid-term, and long-term planning. Although we conducted an expansion study on the Kano model and employed it in a real-life setting, this research had a few limitations. This study only conducted empirical validation research on the household appliance industry, and further research is required to determine whether the conclusions are applicable to other industries. Additionally, whether the UTB model can be transformed into a three-dimensional model using the basic information of an enterprise, such as its funding, time frame, technological capability, and production capability, as the initial input for three-dimensional positioning to output comprehensive planning for the user, market, and technology requires further investigation.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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References

[1] Abernathy, W.J.; Clark, K.B. Innovation: Mapping the winds of creative destruction. *Research policy*, 1985, 14(1), 3-22.

[2] Brown,T. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation. NewYork: Harper Business. 2009.

[3] Feng, Q.; Yu, S.H.; Yang, L. Modeling design of emergency communication vehiclebased on Kano model. *Journal of Machine Design,* 2015, 32(9), 111-115.

[4] Feng, W.W.; Li, Y.S.; Xin, X.Y. Improvement design of family exercise bike based on Kano model. *Journal of Machine Design,* 2015, 32(8), 113-116.

[5] Raharjo, H. Dealing with Kano model dynamics: strengthening the quality function deployment as a design for six sigma tool. *Jurnal Teknik Industri*, 2007, 9(1), 15-26..

[6] Kano, N.; Seraku, N.; Takahashi, F.; Tsuji, S. "Attractive quality and must-be quality", Hinshitsu, *The Journal of the Japanese Society for Quality Control*, April, 1984; pp. 39-48.

[7] Lee, Y.C.; Huang, S.Y. A new fuzzy concept approach for Kano's model. *Expert Systems with Applications,* 2009, 36(3), 4479-4484.

[8] Luor, T.; Lu, H.P.; Yu, H.; Lu, Y. Exploring the critical quality attributes andmodels of smart homes. *Maturitas,* 2015, 82(4), 377-386.

[9] Schumpeter, J.A. Capitalism, socialism, and democracy. London: Routledge. 1976.

[10] Tidd, J. Technological innovation, organizational linkages and strategic degrees of freedom. *Technology Analysis& Strategic Management,* 1993, 5(3), 273-283.

[11] Von Stamm, B. Managing innovation, design and creativity. John Wiley & Sons. 2008.