

Design of the Stations and Trains of JR East Railway Company

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A feeling of "comfort" is an emotion that results from an awareness of the environment, circumstances, experience, and psychological status. For this reason, in order to ensure comfort, various conditions need to be taken into consideration and the space and articles involved need to be concretely identified. This process is none other than the process of design. Stations and trains that constitute the management resources of JR East Railway Company are designed from a variety of perspectives. This paper will attempt to explain our company's design concept of stations and trains taking historical flow into consideration.

I Introduction

A person feels comfort as a result of awareness or supplementation of external and internal elements such as the environment, circumstances, experience, and psychological status. In the case of a railway, human response is a composite of environmental conditions in the stations and trains, memories of having used such facilities in the past, the characteristics of the location of the station, and the route to be taken. All of these factored together result in a feeling of comfort. When thought is given to this, in materializing a station or a train, consideration needs to be given not only to functionality and form, but the design must also actively incorporate methods for reviewing efforts towards achieving comfort as an important element. In the materialization of stations and trains, various other elements are brought into the design work in a comprehensive manner. This paper concerns the design of the stations and trains of JR East that have been materialized as concept, space, function, and form giving actual examples that draw from the past.

2 Design of JR East Railway Stations

In April 2003, the former Shimbashi Depot (Figure 1) opened at the Shiodome Shio Site. The land that was formerly used as the Shiodome Freight Station was reborn as an office building, hotel, and theater complex and the two-floor Shimbashi Depot was constructed among the glass encased high rises while its original external appearance was maintained. After perusing the railway historical



Fig.1: The Former Shimbashi Depot Replicating its Appearance When First Built

display and station foundations that have been designated national historical artifacts, visitors may partake of meals at the first floor restaurant. The novelist Kafu Nagai wrote, "Sitting vacantly in the waiting

room of Shimbashi and listening to the apparently busy sound of wooden sandals makes me feel that I have embarked on a trip without moving, providing me with a free yet wistful feeling" (Kochano Ato (After Tea) 1911). Visitors to the rejuvenated former Shimbashi Depot will surely think back to the history of railways and stations that began from this small structure (Figure 2). In the sections that follow, the design of the stations of JR East Railway Company will be explained looking back into history

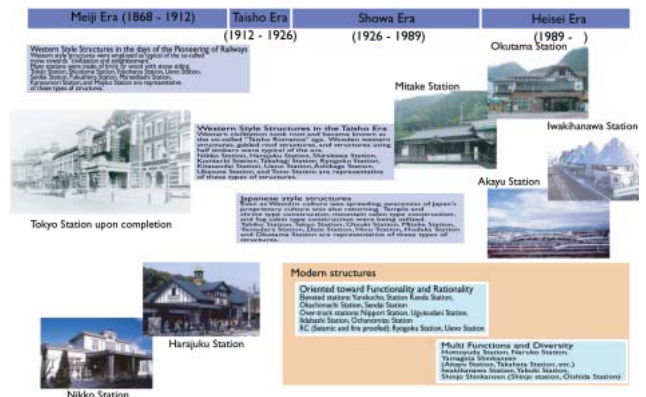


Fig.2: Transformation in the Design of Stations

2.1 Western Style Station Structures and Japanese Style Station Structures: The Two Routes of Station Design

While both Shimbashi Station and Yokohama Station were built using the timber framed stone sided method (Note 1), numerous stations that were built during the pioneering heyday of the Meiji Era used the Western method of design which employed brick. These were typical of the so-called "era of civilization and enlightenment" (commonly called "Bunmei Kaika" in Japanese). Early stations were simple in that they were designed around a central hall and had ticket gates and waiting rooms spread about, but as railway routes grew and Japan become more prosperous, Tokyo Station was constructed as the nation's central station. It was built with a stately brick facade facing



Fig.3: Tokyo Station When First Opened
(Property of the Transport Museum)

the Imperial Palace (Figure 3). In the Taisho Era when Western culture became entrenched, construction of wooden Western style station structures began. Harajuku Station, which is enroute from the Jingu woodlands to Omotesando and Takeshita Dori, employed a half-timber method ^(Note 2) as the frame and is characterized by its towering gabled roof. Nikko Station (Figure 5) is equipped with a VIP room and has a symmetrical external appearance (Figure 5) while the front external wall of Shirakawa Station (Figure 6) is decorated with a windowed gabled roof.

During the Showa Era prior to World War II, however, awareness of proprietary Japanese culture returned and Japanese style structures began to be used in the design of stations. In cities with a long history of famous temples and shrines, stations were constructed in the motif of such temples and shrines and mountain cabins. Yahiko Station (Figure 7) near Yahiko Shrine, Takao Station close to the Imperial Tomb of the late Emperor Taisho (Figure 8), and Okutama Station at the foot of the Okutama hiking course (Figure 9) are examples of these.

As can be seen, locations where "Western station structures of the Taisho Era" and "Japanese station structures" can be found create unique scenery in their respective communities leaving their legacy to the current generation.

2.2 Modern Station Construction: Functionality and Technology

"Modern station construction" of concrete and with steel structures and other new materials and technologies that place emphasis on functionality began to appear from the end of the Meiji era. At the elevated Yurakucho Station, the concourse was located directly below the platforms in order to simplify the movement of people and the over-track station at Ochanomizu (Figure 10) digressed from the legacy concept that assumed that people tend to gather at stations and was designed to allow the flow of people. This had a profound impact on the design of future commuting stations. When the importance of seismic resistance was recognized as a result of the



Fig.4: Harajuku Station



Fig.5: Nikko Station



Fig.6: Shirakawa Station



Fig.7: Yahiko Station



Fig.8: Takao Station



Fig.9: Okutama Station



Fig.10: Ochanomizu Station



Fig.11: Ryogoku Station



Fig.12: Ueno Station



Fig.13: Sendai Station

Great Kanto Earthquake, Ryogoku Station (Figure 11) and Ueno Station (Figure 12) were constructed using steel structured reinforced concrete. Station design was influenced by a new construction design movement from the West, Secession ^(Note 3), by which the external form moved away from the construction format of the past so as to emphasize functionality, and in the interior, vaulted ceilings were often used.

While numerous stations were damaged during World War II, with the post-war recovery and the advent of the age of mass high-speed transit in the years of high economic growth, orientation toward functionality in the design of stations became more pronounced.

Large multipurpose buildings were born and elevated stations and over-track stations have increased in response to advanced urbanization, and the structure of Shinkansen stations has been standardized. While there are cases such as Sendai Station (Figure 13) where wooden structures and overpasses are designed so as to be integrated with pedestrian decks in a proprietary manner, many stations are designed in such a way as to blend with the station building and overpasses.

2.3 Creation of New Stations

It can be said that in the past, stations were designed by employing the then prevalent methods of construction to design the exterior and then planning the functional movement of people within the station. However, as the times have changed and so has the nature of transportation, this has brought about changes to the character of stations. With Shinkansen having been extended to the northern part Tohoku as well as to Nagano, and mutual track-sharing such as in the case of the Shonan Shinjuku Line, a total of 16 million people use JR East Railway Company stations daily. With shopping, sleeping accommodations, and other facilities located within stations, stations are now intricately related to everyday life such as dining, shopping, and making use of other available services. With the space above the rails having been developed, Shinagawa and Tokyo stations are promoting redevelopment programs of their respective areas with each station playing a central role. As has been seen, stations have changed from being merely facilities where passengers board or disembark from trains, as the case may be, to something that has become a part of everyday life. JR East is currently taking a fresh look at stations from the perspective of the users. In recent construction design, rather than choosing a design that is purely oriented toward function and has no consideration for aesthetics, greater emphasis is being placed on design that takes into consideration the aging society through choice of materials and the use of natural light. Design must now seriously respond to the needs

of the consumer. JR East Railway Company designs stations with full consideration to those who will be using the facilities. The company targets the creation of stations that harmonize with the atmosphere of the community and act as space that will remain in memory and provide pleasantness and liveliness.

Let us now look at recent station designs from the perspective of the flow of people in a station, the liveliness of the station, and its relation to the local community.

2.4 Flow of People in a Station

Commuters rush along the concourse and passengers who intend to board Shinkansen trains wait for their departure time in the waiting room. Some people are shoppers, others may have appointments, some may be in a hurry and others relaxed, and the station must be able to respond to all these needs.

The renovation of Shibuya Station was completed in March 2003. As Shibuya Station is used by a large number of people on an everyday basis, it was not easy to begin the renovation work, and the station was dark and confusing for a long time. For this reason, the map-format ticket vending machines were installed on an incline to allow greater visibility, and the numerous miscellaneous advertisement billboards were rearranged and separated from station guide signs. The ticket gate and steps that were difficult to discern during rush hours have been redesigned in ways to make them more visible as entrances and stripe signs have been painted on the ceiling, and the platform numbers are displayed in large numerals on the walls. The automatic "Suica card" system allows passengers to flow non-stop to the platform via escalator or elevator. As a result of the dissemination of the Suica card, the number of passengers at stations has increased (Figure 14).

There are areas at stations put aside for relaxing. The Silver Bell Rendezvous Room at Tokyo Station has photos on the walls and floor of Tokyo Station back in the days when the station was first opened and its indirect lighting creates a relaxing atmosphere (Figure 15).



Fig.14: Suica Automatic Ticket Gate



Fig.15: Tokyo Station Silver Bell Rendezvous Room



Fig.16: Babies' Resting Place



Fig.17: Granduo Tachikawa



Fig.18: Hotel Mets Mejiro



Fig.19: Grand Concourse of Ueno Station

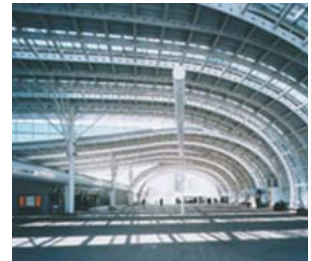


Fig.20: Saitama Fukutoshin Station

Cafes and foot care stores are located in the vicinity of the rendezvous room and the restrooms are multi-functional, serving as resting places for babies (Figure 16) as well as powder room. In order to ensure that the restroom facilities are always kept sanitary, the toilet bowls have been made larger and the wall and floor tiles have also been made larger to prevent bad odors. The floor water discharge system and air conditioning in the booths have also been improved. When the preservation work on the Marunouchi side of Tokyo station has been completed and the Yaesu Twin Tower is built, the flow of people in this station will also increase.

2.5 Liveliness of Stations

Exiting the ticket gates, the passenger of today now finds himself or herself in a station building or hotel, and more time is being spent on the way home from work or school and on weekends in these facilities. JR East Railway Company is working towards curbing vibration due to the passage of trains and undertaking other such initiatives in order to make stations more lively.

Granduo Tachikawa (Figure 17) and the Tokyu Meguro Building utilize a new design method in the structure of levels on which the rails are laid and in the fireproofing to create the station as a single unit above the rails. Hotel Mets Mejiro which opened in October 2003 (Figure 18) is in the vicinity of Mejiro Station, but provides a view of the quiet wooded area of Gakushuin University. Dream Gate Maihama which is to be constructed below elevated railway facilities will be constructed using the self-installing brace method (refer to specialized paper). New technology is continuously being developed and the station space is being extended.

Natural light is being provided into stations so that customers can see the time of day and the outside weather. The huge roof of the main concourse of Ueno Station (Figure 19) has been renovated into a dome, preserving the iron framework, and there is a huge space through which natural light enters from the ceiling. Its walls are decorated with paintings by Genichiro Inokuma, stained glass by Ikuro

Hirayama, and a statue of a young girl. At the emerging Saitama Fukutoshin Station (Figure 20), natural light enters from the wave-like roof that covers the concourse and the light-and-shadows on the floor change according to the time of day.

2.6 Relationship between Station and Community

A station is a place through which people pass as the gateway to a community, a place where information is exchanged, and it is part of the landscape of the community. By making station space a place that will stay in people's minds and by incorporating the features of the community into the station, the relationship between the station and the community can be enhanced.

At Ueno Station (Figure 12), the plastered roof of the gallery is used as an art gallery and the VIP room and office rooms have been converted into a restaurant. The space under the elevated Shinobazu Exit that had been used as a backyard has now become a series of shops. While utilizing the concourse and structural features that have long been familiar to station users, safety has been enhanced through such work as installation of disaster prevention equipment, Saigo Exit and Yamashita Exit that lead direct to Ueno Park have been created as well as connection to subway lines via escalator, with consideration for the flow of people. At Shibuya Station (Figure 22), the facade^(Note 4) that had been hidden from view among the miscellaneous buildings, displays, and crowds of people in the square has become visible as a result of these having been changed to a glass surface with a design that depicts clouds flowing in the sky. People waiting to meet their friends and associates at Hachiko Square can be seen through the glass from the station platform. The urban station that had in a sense been buried in the community has been reborn, and the flow of people from the station into the community has also changed.

In small local stations, efforts are being made to consolidate stations with community centers, libraries, galleries, and spas to form a facility where people can gather to create a local setting. At Oishida Station



Fig.21: Internal Appearance of the Main Hall of Ueno Station



Fig.22: Hachiko Exit of Shibuya Station



Fig.23: Oishida Station



Fig.24: Hitachihanawa Station

(Figure 23) on the Yamagata Shinkansen, the step-shaped roof provides a place to sit and observe the scenes below. The community of Oishida has prospered as a river-boat center on the Mogami River and the steps that form the roof are made from roof tiles that conjure an image of the stairs leading down to the pier. At Iwakihanawa Station (Figure 24) on the Suigun Line, which is comprised of a series of conical roofs, a library with more than 30 thousand books and a gallery are available to pass the time while waiting for a train.

In the future, patrons will be able to use their Suica cards in station shops, station concourses will be enlarged, and transfer to other trains or other means of transportation will become more convenient. The artificial foundation above the rails will give rise to liveliness and comfort and we can look forward to community development with the station as the center. JR East Railway Company intends to provide designs that achieve not only comfort for the people who use the stations on an everyday basis, but also at the same time, making each station a memorable place visited during a trip.

3 Vehicle Design by JR East Railway Company

JR East Railway Company was established in April 1987, and a new era of railways began. In the days of the former Japan National Railways, vehicles were considered simply as a means of transportation according to the rationale of the vehicle manufacturers and such vehicles were standardized based upon the assumption that they would be used throughout Japan. JR East Railway Company

now considers the vehicles as a kind of product, and based upon an examination of such thinking, we have been developing designs based on marketing research and total comprehensive design. In this section, concrete examples and expectations for the future will be presented.

3.1 Design of Limited Express Trains

(i) 651 Series "Super Hitachi"

The first new vehicle announced after the establishment of JR East Railway Company was the 651 Series "Super Hitachi" (Figure 25). The legacy limited express "Hitachi" had an average occupancy of 71%, which was top-level among legacy limited express trains but the vehicles were rapidly becoming antiquated. Moreover,

for "Hitachi" that runs on the Joban Line, the development of Tsukuba Science City presented opportunities for increased demand, but on the other hand, with the development of the express bus service networks, there was a threat that the route might be a failure. JR East Railway Company determined that the target of the new type of vehicle to be introduced would be business people and, in addition to reducing the travel time by operating trains at speeds of 130 kph, we aimed to increase demand by providing comfortable services. In the development of the vehicle, industrial designers were asked to participate in order to determine the design concept and to move forward toward a concrete design. The total concept of "Super Hitachi" is "New Standard," the exterior concept is "Simple & Dynamic," and the interior concept is "Hospitality." As with automobiles, the front design was reviewed using three dimensional clay models and the design sporting a large LED sign positioned at the nose was extremely innovative for the day. On the other hand, the seat pitch was increased, continuously-adjustable reclining seats introduced, indirect lighting and reading lights installed, and comfort as a whole was significantly enhanced (Figure 26). As a result of the introduction of "Super Hitachi," passengers using the Joban Line have increased by 11%. Moreover, "Super Hitachi" is the recipient of the international railway design Brunel Award.

(ii) 251 Series "Super View Odoriko"

A train that typifies the "Break Away from Standardization" trend is the 251 Series "Super View Odoriko" (Figure 27). The 185 Series "Odoriko" that was designed in the days prior to privatization was a



Fig.25: 651 Series Super Hitachi



Fig.26: Interior of the Super Hitachi Cabin



Fig.27: 251 Series Super View Odoriko



Fig.28: Glass Positioned Structure of Super View Odoriko



Fig.29: Group Seats on the Super View Odoriko



Fig.30: Children's Room on the Super View Odoriko

typical standard vehicle. The key word in the design of "Super View Odoriko" was "board the train and find yourself in Izu" and in the development of the vehicle, the cooperation of not only of industrial engineers but also of the construction department of the company was obtained. The vehicle is comprised of a double deck section and a high deck section with large glass panes installed at the front and the sides to allow passengers to enjoy the passing scenery (Figure 28). In addition, the positioning of seats in normal grade cabins has been separated into "seats for couples" and "seats for groups" while in the green-car cabins, the choice is between a dome car or private room. A "salon" and "children's room" have been installed in the corridor of the double deck section, thus making a clean break with what had been considered common sense in the past. In terms of software, dedicated "View Ladies" provide services and the train is eminently suitable as a resort train (Figure 29, Figure 30).

(iii) Series 253 "Narita Express"

Since the spring of 1991, transportation linking Narita Airport to

central Tokyo has been in operation. In order to provide convenience and specialization with respect to competing systems, JR East Railway Company decided to develop the Limited Express 253 Series "Narita Express" that would run from such terminals as Shinjuku or Yokohama directly to Narita Airport (Figure 31). The design concept of the 253 Series vehicles was "Value Added Transport Space" in order to provide comfortable travel to Japanese people traveling abroad and foreigners visiting Japan. Through actual experience of riding on private lines and airport limousine busses by designers prior to the development, and from subsequent customer feedback at the airport, the single most pertinent issue was identified as the provision of luggage space, and this was positioned as the most important point in interior design. Concretely, space for large pieces of luggage was positioned on the deck of the cabin (Figure 32) and, in addition to the hat rack above the seats, in ordinary grade cabins that tend to become crowded, French parallel seats were placed facing each other in order to create space for luggage between the backs of the seats (Figure 33). Moreover, the green-car class seats were positioned to emulate first class or business

class seats of airlines.

The most significant issue with respect to the exterior design was the design of the front section. In order to shorten the time for uncoupling and coupling with other trains at Tokyo Station, an automatic coupling and uncoupling device was newly developed and the structure even allowed for automatic corridor connection. For this reason, in the process of designing the driver's cabin with this device positioned at the center, the total design of the exterior was determined. Moreover, for the external color of the train, a traditional color from ancient Japan was selected to give visitors from abroad a feeling of having arrived in Japan. "Narita Express" has since become



Fig.31: 253 Series Narita Express



Fig.32: Large Luggage Space on the Narita Express



Fig.33: Ordinary Class Cabin of the Narita Express

indispensable for accessing the airport. The train was awarded the Brunel Award in 2002.

3.2 Design of Commuter Trains

209 Series Commuter Trains

The 209 Series commuter train (Figure 34) was developed targeting strict reduction of maintenance, energy costs, and cost of manufacturing under the concept "half product cycle, half weight, and half cost." Later, this vehicle evolved into the E217 Series and the E231 Series that incorporates a control system called TIMS that makes full use of information technology in order to enhance safety in the event of a collision during urban use. Today, these series are the standard for commuter trains not only for JR East Railway Company but also for privately operated lines.

The 209 Series trains targeted "people friendly trains." For example, such initiatives included a sensor function for detecting objects stuck in the door, achieving flatness of the door window through use of adhesives (in order to prevent being drawn into the door pockets), facilities for people with physical challenges (Stanhope facility that prevents falls, space for wheelchairs, displays showing the next station or chimes that indicate the opening and closing of doors), increased size of seats, use of bucket seats, partitions at both ends of a row of seats, and increased number of poles for stabilization (Figure 35).



Fig.34: 209 Series Commuter Train



Fig.35: Interior of the E231 Series

In the development of the 209 Series, a postcard questionnaire survey was conducted among customers on a pre-mass production prototype 901 Series. About 17,000 postcards were distributed and of these, about 50% were returned. Of those returned, some people had used

the section provided for expressing opinions freely to the fullest extent stating their opinions, and demands. This was a case in which the dissatisfaction and demands of passengers using commuter trains were clearly indicated. It was an example that taught us that it is with the commuter trains in particular that close attention needs to be given to the requirements of the customers in undertaking design.

The 209 Series was awarded the "Good Design Award" for the transportation equipment section. In the past, awards have been monopolized by automobiles and this was the first award to be given to a railway car.

3.3 Design of Shinkansen Vehicles

On the one hand, Shinkansen vehicles are characterized by the fact that they travel at very high speeds and for this reason there are design limitations that are not encountered in the design of trains that run on normal gauges. However, it can also be said that analysis from the perspective of aerodynamics leads to the creation of beautiful forms. A typical example of this may be the E2 Series Model 1000 (Hayate) (Figure 36). Characteristic of this vehicle is the low center of gravity targeting safety during operation, the adoption of an active suspension system, the use of flat nose and sides in order to reduce noise and statoric waves, and low noise pantograph (Figure 37). These initiatives towards enhanced performance led directly to the characteristics of the design. The concept of the exterior design is "Dynamic & Graceful." On the side of the body of "Hayate," a symbol mark (Figure 38) that represents an apple, the chief agricultural produce of Aomori Prefecture, emphasizes the local color.

One of the characteristics of the Shinkansen transport of JR East Railway Company is commuter transport to metropolitan Tokyo and direct connections from Shinkansen to ordinary gauge lines. The E1 Series (Figure 39) that was developed in 1994 was the first all double-decker vehicle in Japan and featured six seats in a row on the second level non-reserved section and new initiatives such as placing control devices directly below the floor were introduced for the first time.

The E4 series (Figure 40) that made its debut in 1999 was developed based on the E1 Series incorporating an aluminum body and enhancing measures having to do with the statoric waves at the nose of the train. Moreover, the total passenger capacity of the E4 Series of a two-train configuration of 16 cars became 1,634 or the largest in the world and the system became one that can respond to fluctuations in transportation demand in a flexible manner. Moreover,



Fig.36: E2 Series Model 1000 Hayate



Fig.37: Hayate Low Noise Pantograph



Fig.38: Hayate Symbol Mark



Fig.39: E1 Series Shinkansen Train



Fig.40: E4 Series Shinkansen



Fig.41: E3 Series Shinkansen

the motif of the design of the E1 Series Renewal trains such as "Toki" and "Nihonkai" takes its inspiration from Niigata Prefecture. The 400 Series and E3 Series (Figure 41) that was developed for use on the Yamagata and Akita Shinkansen lines have a train width that is the same as is used with standard gauge rails. When stopping at a Shinkansen station, a step protrudes to fill the gap between the train and the station platform. The train is also equipped with automatic coupling for use with Shinkansen lines. With consideration given to the local landscape, the pattern of the curtains of the E3 Series "Komachi" uses the motif of the Akita Kanto (lantern) Festival.

3.4 Vehicle Design of the Future

To this point, the initiatives of JR East Railway Company in vehicle design in the past have been explained. In fiscal 2002, Tokyo Monorail joined the JR East group and in the future, the company intends to form "design concepts as the JR East group" and with respect to vehicles, to make every effort to form a JR East Brand" as seen from our customers' perspectives. In 2002, in a "Meeting for the Exchange of Ideas on the Design of JR East Vehicles," a proposal was made on the items for evaluating the design of vehicles (Figure 42). In the future, the needs of the customer and the overall

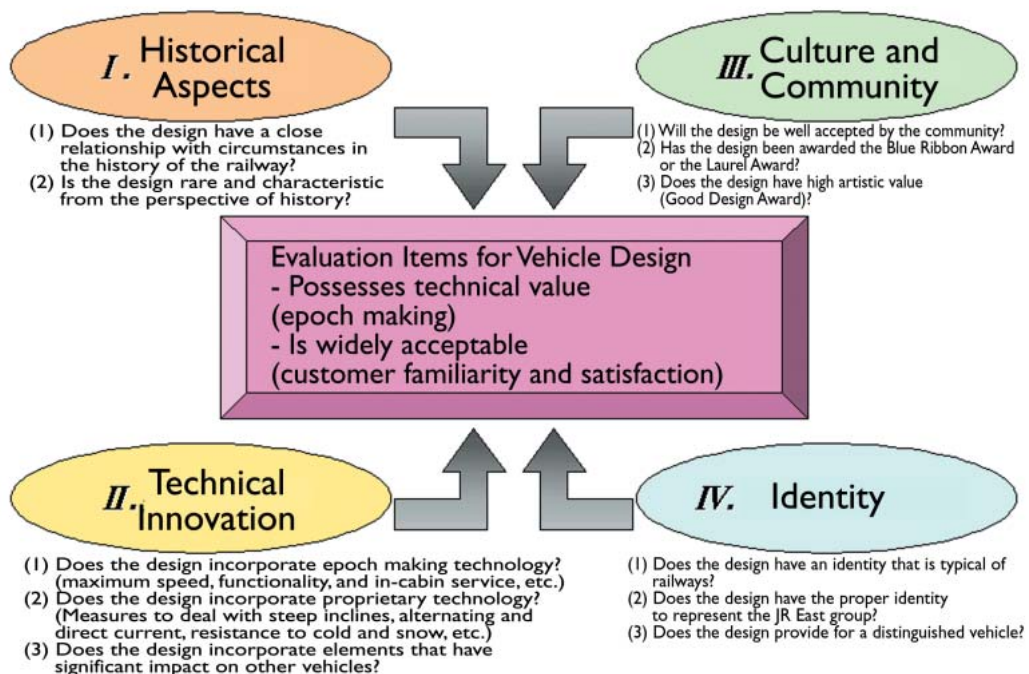


Fig.42: Standard for Evaluating Vehicle Design

trends of society will be researched based on this in order to determine concrete targets on comprehending such needs and the formation of a brand and the company intends to make every effort towards developing vehicles that are ever more comfortable for customers.

4 Conclusions

The discussion has been on stations and vehicles with respect to the design undertaken by JR East Railway Company and it is hoped that each of such design initiatives are realized in a variety of circumstances. However, it is also true that considerations given to design may not be directly understood by customers and for this reason, it is necessary to conduct marketing research and to listen carefully to the opinions of customers. Last year, a restructuring of the concept upon which the design of JR East Railway Company ought to be based was commenced. JR East Railway Company needs not only to be aware of the importance of trains and vehicles that constitute important business resources, but also must be capable of compiling what should be considered and what should be expressed as the charter of its design efforts. The company will target the realization of stations and trains of which it can be proud on a global scale.

(Note 1) This type of structure involves laying stones on the outside with the wooden frame providing the support. Externally, this type of structure looks like a stone structure.

(Note 2) This is Western style construction whereby pillars, girders, or braces (diagonal structural material) are exposed on the outside as structural material and the gaps between the pillars are filled with plaster. This type of construction is often seen in traditional residences in Germany and England.

(Note 3) This is a school of architecture that rejected the Art Nouveau style and called for a harmony of functionality and beauty through simple geometric design. The school is thus called Secession.

(Note 4) The word "facade" is originally French and means the "front". It refers to the external appearance of the front of a structure (it is quite normally used in the English language).

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