Navigation Development Dedicated for Alphard/Vellfire

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1 Introduction

In recent years, a need for car navigation (hereinafter referred to as "navi") is greatly increasing in size and image quality of the screen. Each navigation manufacturer has been developing navi products for dedicated vehicles including vehicle clusters, parts of instrument panels and etc. due to large-sized navi display, and bringing them to the after-market to perform preceding launch in the dealer option market. Then this movement is successful and spreading. On the other hand, a widely used navi with general size display (7 inch/9 inch) which was for installing to a vehicle that had common navi opening (installing part) had been mainly sold in TOYOTA MOTOR DEALER as an option (**Fig. 1**).

We have experience in developing line-fitting option products and exclusive vehicle navi for after-market. By fusing these technologies, we made plan to develop a large display navi harmonized with each vehicle as a dealer option. As a result of our proposal of this plan to TOYOTA MOTOR, a navi with 10 inch display exclusive for new Alphard/Vellfire was adopted and released this time.

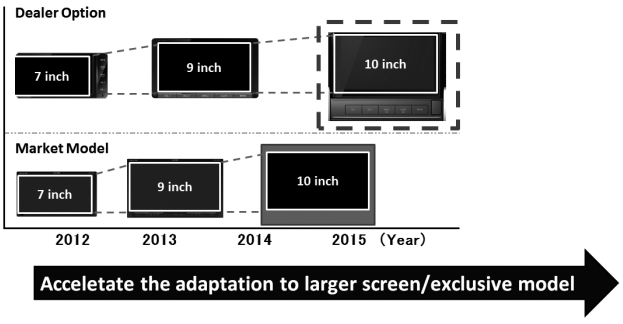

Fig.1 Market Trend

2 About Exclusive Navi for Alphard/Vellfire

This product uses general dealer option navi with 9 inch display (developed by us) as a mother body, and includes the 10 inch liquid crystal display (about 1.2 times in size compared with 9 inch model) installed on the part of opening - closing type screen, a touch panel of an electrostatic capacitance system for operation via screen and a main body with hard button part and a screen part separately.

This navi product is exclusively harmonized with each vehicle in order to make it equivalent to line-fitting option products by matching its design with vehicle interior part in shape and coating color of interior (color tone and gloss), and also matching the illumination color and operation feeling of the button with peripheral part, besides reducing gap between the vehicle interior panel and the product. (**Fig. 2**)

Fig.2 Navigation Mounted State

The product is composed of navi main body on which screen part and hard button part are fixed by dedicated vehicle bracket, and register panel parts (R side /L side). For installation to the vehicle, first, existing hazard button is inserted into the side of hard button part, and a main body of navi is installed to the vehicle. Then by attaching existing fin units to resister panels, and installing them to a navi main body to the side of navi screen, processing of vehicle part is not necessary in the same way as the conventional general model, and this makes the work simple. (**Fig. 3**)

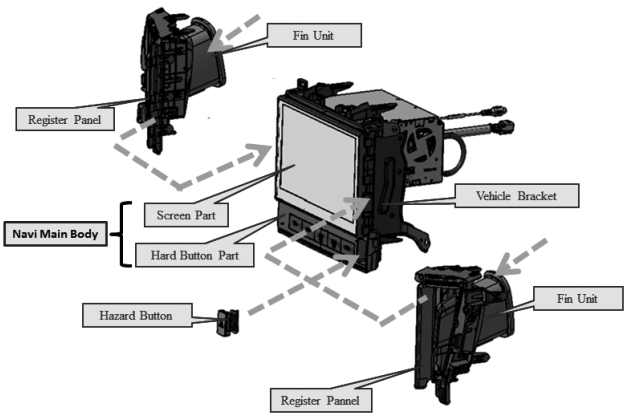

Fig.3 Navigation Products Structures

3 Issues for Navi Development

We had two big issues in this development. First issue was short-term development. When navi development started, the new model vehicle for the navi to be installed had been already under development. It was clear that the navi had to be sold after vehicle was launched. Thus, short-term development took on top priority because it needed to be on the market within the possible shortest term after vehicle sales started. About 13 months were necessary from development start to product sale for the same scale project as this product until then. However, we started the development by setting our goal to shorten this development term to 10 months, and launch the product to the market in the shortest time after vehicle sales started **(Fig. 4)**

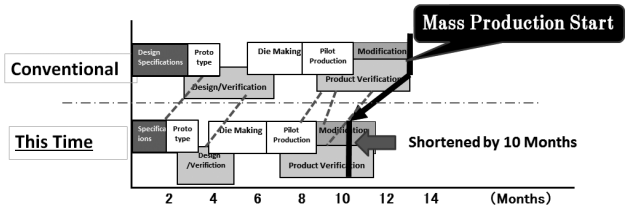

Fig.4 Development Schedule Comparison

Second issue is from the fact that this navi is exclusive model for each vehicle unlike general model as described above. Namely, its visual aspect needs to match to vehicle interior design and painting appearance, and the gaps and steps between it and the vehicle is to be uniform when mounted, in order to be comparable to line-fitting option, besides button feeling of vehicle.

Our approach for this product development towards these two issues is explained in the next chapters.

4 Approach for Short-Term Development

4.1 Measure at the step of Specification Decision

In regard to the specification decision making with TOYOTA MOTOR CORPORATION, there are three items to be examined, which are design, confirmation of requirement for installation (visibility and safety) and mounting workability. At the decision step for these three specifications, performing verification work on 3D CAD data is first, however, it is more necessary to produce an actual part and inspect it which cannot be inspected enough with 3D CAD data. Conventionally, it took more than a few weeks to produce a prototype by use of cutting processing, and this was inefficient. Therefore, by use of 3D printer, we were able to complete making the prototype within a few days and carrying out inspection, and to greatly shorten the term for making the decision of specification this time.

At the design study step, steps and a curved surface are confirmed by designer in the vehicle-mounted state of the product, then the decision of specification was also smoothly made with confirmation of an actual prototype by using 3D printer. Moreover, at the step of inspection for confirmation of requirement for installation (visibility and safety) and study for mounting workability, the influence to the shift lever and button operation, and to the visibility of the display part like a meter or other are confirmed, and for workability, the way to hold the products and the space for hands/tools and so on can be actually confirmed. It also took short term for making the decision of specification at this step. The prototype by 3D printer has weak points in durability, strength and chronological change by environment but it has no problem for the limited use.

By use of the prototype by 3D printer, we have had better feedback from TOYOTA MOTOR CORPORATION for its efficient and simple confirmation process besides quick reconfirmation of the modified products. **(Fig. 5)**

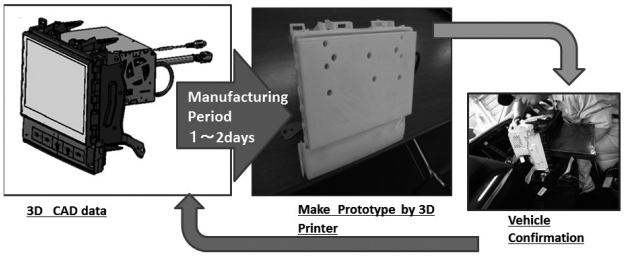

Fig.5 Utilization of 3D Printer

4.2 Measure at the step of Design

For shortening the schedule at the design step, we implemented two measures such as preparation of setting for confirmation of vehicle state and use of design tools.

First, because the target vehicle was under development, the number of evaluation and confirmation of vehicle was limited. Then we needed to get rid of reviewing and reworking by as much as we could solve the issues in our company before the confirmation and evaluation with TOYOTA MOTOR CORPORATION. Therefore, we assembled vehicle parts into the instrument panel and its surrounding part in the testing facility for the persons concerned to check the target vehicle anytime.**(Fig. 6)**

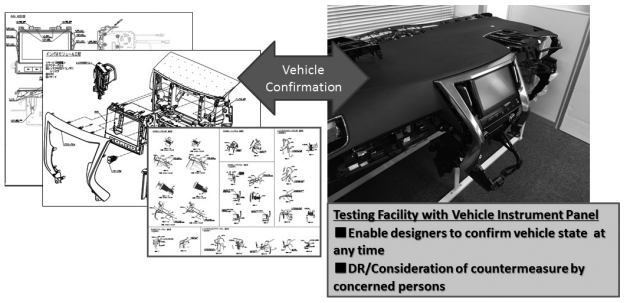

Fig.6 Testing Facility with Vehicle Instrument Panel

This our measure enables designers to improve their image of the product more than study on the desktop and on the CAD, and to design faster. Moreover, since the frequent review by concerned persons was possible, activity from identifying issues to improving design in terms of workability for installation, wiring process and so on were able to be smoothly executed. It was also able to decrease the number of the modification or others in joint vehicle confirmation with TOYOTA MOTOR CORPORATION.

Second, the point is use of blocked design tools. This is our simplified design tool developed uniquely based on design know-how which we have always accumulated.

In this tool, fixing element model is regarded as the structure for the function and clearance etc., and stored to the data base. Designer is able to draw necessary data and finish the design only by inputting minimum customized information.

The design term of this development was also shortened by use of this tool.(**Fig. 7**)

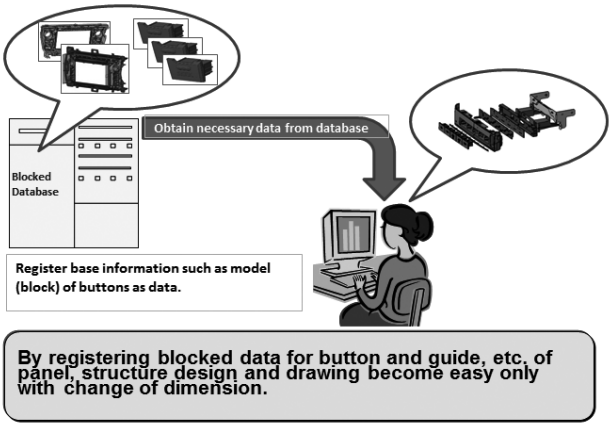

Fig.7 Blocked Design Tool

At the verification scene, there were concerns, especially for vibration durability and rattle sound (abnormal noise) caused by large-sized screen and increase of weight. However, we were able to solve the issues by performing verification at our own rough road test course at early stage and it leaded to short schedule.

5 Measure to equivalent in TOYOTA MOTOR Line-fitting Option

Second issue was how to develop well-studied navi with a large-sized display in total from planning to installation in short delivery time, which is equivalent to line-fitting option product whose design has a sense of unity to the instrumental panel to be installed. In order to solve the issue, we concentrated and utilized three types of know-hows for developing a general-use model of which development term is short, installing a large-sized product to a vehicle and TOYOTA MOTOR line-fitting option product. This "three in one activity" improved design efficiency and enabled to complete our navi product matched to the vehicle in short term, special thanks to the new vehicle information from TOYOTA MOTOR CORPORATION.

6 Conclusion

In future, more high demand in enlargement of the screen and exclusive navi just-fitting to more various types of vehicles will be expected. We would like to put effort on providing our customer with special exclusive model with a sense of unity and high-performance by improving technology which we used in the development this time.

Finally, we would like to extend our cordial appreciation to the all concerned persons of TOYOTA MOTOR who provided great support in the development of this product.

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