# Industrial Design and Human Factors Contributions to the Design of IBM's PS/2

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## Abstract

The contributions of Industrial Designers and Human Factors Engineers to the development of the IBM Personal System/2 Product line has yielded a system of products that exemplifies results which can be accomplished when the two disciplines work toward a common goal. The final system design was the result of concepts which were tested using various Human Factors validation methods which lead to design refinements, with the ultimate goal to fully accomodate the end user's needs. The IBM PS/2 product line was designed for an international market. Emphasis was placed on flexibility to allow the customer various system configurations and upgrades.

The collaboration between the two complementary disciplines resulted in a superior product family with many desirable usability features.

## Introduction

This paper focuses on the collaborative efforts of a design team consisting of industrial designers and human factors engineers involved in the creation of the PS/2 product family. These disciplines are complementary, and by having a close working relationship it was possible to resolve numerous design

questions in a very short time. By bringing these skills together, the ergonomic aspect of the product and its benefit to the user could be refined.

## Design Effort

The activities of the design team supporting the development of the products were centered on three design priciples: early involvement of the design team, with a strong focus on the user and his tasks: prototyping and evaluating alternative designs; and iterative testing. These principles were applied in the design of unpack and set-up procedures, displays, keyboard, system units, mouse, utility programs and tutorial. The efforts of the design team were supported by a firm management commitment to the goal of ergonomic excellence for the PS/2 product family.

Frequent communication between the design team and other product developers was also vital to the good ergonomic design of the final product.

## Studies

One of the first design issues to be resolved was screen size. It was necessary to help management choose between a nine-inch and a twelve-inch cathode ray tube (CRT). It is possible to answer this question scientifically using well-known human factors methodologies. Using paid test participants and collecting performance and preference data a statistically-based recommendation can be formulated. An inherent difficulty of this paradigm is the necessity of having functional hardware which allows the study of the design question. To ensure valid results, units must differ only in the parameter of interest, screen size in this case.

The design team created mock-ups of the two screen sizes using functional prototypes of the two CRT's. Building "neutral" covers for each of the displays helped the test participants judge the displays solely by the size of the CRTs (i.e., eliminated other potential biases).

Other areas in which Human Factors was involved in the PS/2 products include the design evaluation of displays, set-up procedures and documentation. Some of these studies evaluated the effect of high resolution displays on character recognition, the effect of character sharpness on legibility and the effect of glare reduction techniques on character recognition.

The shape of the PS/2 mouse was also determined as a result of prototype studies. A human Factors engineer and an industrial designer worked together to design and evaluate several alternatives. The design was initially based on an assessment of the shape of a hand, and was modified based on the comments of test

participants using prototypes.

The design of the PS/2 keyboard (the Enhanced Keyboard) was influenced by performance and preference testing. Five IBM locations participated in these tests: Austin, Boca Raton, Lexington, Kingston and Santa Teresa. Some of the major differences between earlier IBM keyboards and the PS/2 keyboard were: a dedicated and separate numeric keypad: PF keys arranged across the top of the keyboard, inverted "T" design for the cursor keys and shape, size, texture and color coding of specific keys. The numeric keypad and cursor keys were separated from the alphanumeric keys to accomodate the needs of users who do intensive data entry tasks.

The inverted "T" arrangement for the cursor keys was chosen as a result of a comparison test in which four variations were evaluated. The variations included the cursor keys presented in an inverted "T" arrangement, in a straight line, in the shape of a square and in a cross pattern. By having test participants perform typical tasks with several business applications it was possible to measure differences in performance among the various keyboards while doing realistic jobs. Productivity was demonstrated to be best with the inverted "T" arrangement.

The PF keys were arranged along the top of the keyboard to provide compatibility with associated functions appearing on the bottom line of the display. The shape, size, texture and color coding of keys were also recommended by the design team. A comparison test of the PS/2 keyboard against earlier models indicated a significant preference and productivity gain in favor of the PS/2 model.

Set-up sheets instructing users on the assembly of the products were designed, evaluated and redesigned to ensure ease-of-use. Documentation was also reviewed by the design team and their comments were provided on its effectiveness in communicating instructions. In all cases, the focus was on the user and the tasks to be performed.

## Conclusion

The product's management team was aware of the need for a product that was not only functional but easy-to-use. The Human Factors and Industrial Design departments worked as a close team to provide greater value to the products than if the groups had operated in isolation. Throughout the three-year development cycle, the human factors and industrial design team members worked with many other support and development groups designing the PS/2 products. Management participated in this effort through continuous communication via regular meetings, usability councils and task forces. This combined effort produced the

many distinguishing ergonomic features of the PS/2 products.