Cupertino to Corvallis to Singapore to Melbourne to San Diego: Are We There Yet?

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On this 35th anniversary year of HP handhelds, I would like to briefly touch on some fundamental aspects of HP calculators and examine their trends over time. In order to declare whether these are positive or negative trends, one should probably consider the point of view of the examiner. As an outsider who is trying to understand the historical forces being exerted on the calculator products, my focus is on whether the machines increase capability and increase (or at least maintain) ease of use without much regard for cost. However it is beneficial at least to consider the basic steps required for a calculator to evolve from napkin sketch to shipped product.

An Outsider's View of the Development Cycle

Initially, one must create a machine design based on inputs from a team of one or more individuals. Once the design is firm, the specifications are communicated to the manufacturer. (From the days of the Advanced Products Division in Cupertino through the Corvallis Division, the designer and builder were both HP, so the manufacturing facility may have only been a short walk from the engineer's drawing boards. In more recent times, an outside manufacturer has been utilized.) If the manufacturer is unfamiliar with many of the criteria evolved over years for successful HP hardware, these specs might have to be spelled out in excruciating detail so nothing is overlooked.

Following the manufacturing process, product is packed and shipped to distributors and vendors. There might also be some concurrent marketing and publicity to make the buying public aware of the release of the new product. (Lately there has been way too little of this for HP calculators, in my opinion.) Calculators are sold by mail, retail and on line and (hopefully) everyone in the chain starting with HP make some profit in the sales. With this profit, designers get paid, more designers may be hired and with feedback incorporated from the users, perhaps additional calculators may be conceived, allowing the process to repeat itself.

The Eternal Struggle

During the development cycle, many factors come into play which participate in the "tug of war" between maximizing profit and sales versus improving technical capabilities. A device which is primarily designed for students might sell better to them if it looks "cool", but this obviously doesn't make the device work any better. A fixed budget might be allocated such that significant dollars are funneled away from design engineering in order to support marketing, and thus an inferior machine supported by lots of ads might outsell a superior machine about which few people have been informed. Often times, a company decides it wants to "get a foot in the door" in a certain market and the quickest and least expensive way to achieve this might be to utilize an existing generic (and not necessarily well-thought-out) third-party calculator design and affix their company logo on the case. The ultimate effect on the company's reputation becomes anyone's guess in this case.

When HP's Australian Calculator Operation (ACO) in Melbourne resurrected the business from Singapore (where it seemed to lay dormant for a few years), it appeared that the pendulum had swung over from the technical excellence side to the profit-priority side. Perhaps this was intended to be a temporary way of jump-starting the group again with some much-needed cash. In any case, the release of the 6S, 6S Solar and 30s calculators were unlike any HP machines before them, where virtually all of the

legacy “family jewels”-type characteristics (such as high-contrast function lettering, tactile-feedback buttons, RPN-logic capability, concern for minimizing keystroke counts, etc.) were ignored. Since the 6S and the 30S physically and functionally resembled other manufacturers’ units already in the marketplace, one was led to conclude that these were basically “rebadged” calculators. Whether the hoped-for cash streamed into ACO at that point is any outsider’s guess. In any case, the veteran HP users pretty much scratched their heads, wondering whether the company had lost its way. Meanwhile, soon after, the entire group was disbanded and all projects (including the promising educational Xpander and Linux-based PDA the Jornada X25) were cancelled or put on hold.

Around 2002-03, when the San Diego group was attempting to restart calculators again, they also had designs on generating some quick cash (as far as we can tell) and put out the hp9s and hp9g. These two machines resembled the 30S so much, we outsiders concluded this was another pair of rebadged machines from the same vendor. The new-fangled term for the San Diego group’s initial approach to calculators was “Strategic Touch Model”, which we interpreted to mean that HP attempts to only provide detailed specs and perhaps technical support information while relying on the third-party manufacturer to completely implement the hardware and firmware. This can work if the specs are clear and complete and the vendor does not attempt to sneak in any short cuts which might jeopardize quality or reliability. When the 10BII and 17bII+ were released, we saw legacy firmware in a new case and hardware design, presumably to reduce cost. The results were mixed from a user-feedback standpoint, with the 10BII experiencing some issues with its keyboard and the 17bII+ appearing like a cheap knockoff of its Pioneer-Series ancestors. Since the professional business user has been considered HP’s “bread and butter”, you would think that they would desire to provide a more acceptable look and feel to this community which traditionally would be willing to purchase a more expensive machine in exchange for prestige and reliability. Later, in an attempt to enter the Asia-Pacific educational and basic-scientific market, they produced the hp8s calculator, a machine similar in functionality to the 6s and 30s and again (as far as we know) with firmware basically selected off the shelf and bearing no resemblance to any legacy HP scientific machines. Hopefully, these strategic moves have generated the cash which the organization required in order to sustain itself while planning more substantial homegrown designs.

Meanwhile ACO’s hp49g, which had greatly improved functionally over the 48 series but presented serious compromises in keyboard quality and key layout, was given a hardware upgrade by San Diego in the 49g+. After a handful of iterations attempting to return the key feel to that of the 48, they began to get it right. More recently, the 50g refreshed the 49g+ and the keyboard feel is extremely good.

Considerations and Trade Offs

The purpose of this paper is to discuss specific changes which have occurred recently in the calculator models which either extend features considered to be beneficial to the user or those which reduce usability in one way or another. Back in the Corvallis days of 1978 through 1994, for the most part, functionality and capabilities seemed to improve from one generation to the next. Display sizes grew in order to provide more and more information at a glance, keyboard quality was maintained at a high level, flexibility and ease of use was retained or improved, programming power improved, memory sizes grew and costs fell. Certain features did come and go, but in general, the direction of the business seemed clearly headed towards better, faster, less expensive. After Corvallis, things changed, however. Perhaps the ubiquity of the personal computer made the calculator less important to technical professionals and the student market seemed the only viable place to pursue significant sales. Also, the changing of personnel from the Corvallis team to Singapore, Australia and now San Diego caused an erosion of the knowledge of what was considered the most important qualities of HP calculators to long-time loyalists. Each time a new team arrived, the users attempted to remind the next group of the importance of certain traits and

features. This effort has begun to pay off in returning to some of the best capabilities and qualities of the Corvallis past. In other areas, more work is needed.

Issue 1: Long Live the Large ENTER Key

Since the HP35 in 1972, we have seen a large ENTER key in some form or another. Even when pure algebraic machines were first released starting with the HP18C in 1986, the large INPUT key at the middle of the keyboard represented the HP brand more than anything else. However in 1999 with the hp49g, there was an attempt to appease the algebraic users by shrinking ENTER and relocating it down at the bottom right like the other manufacturers. In the flagship RPL models and algebraic student models from 2000 on, this positioning has remained, much to the dismay of the traditional HP users. Another example of this was the release of the hp33s, which was a 2004 refresh of the 32sII Pioneer unit. However, recently the San Diego group did another upgrade with the hp35s and the large ENTER has returned in this mid-line scientific model. From the excitement generated in the experienced-user community, this has been a very positive step.

Issue 2: Key-front functionality and Controlling Keyboard Clutter

Starting with the HP65 in 1974, when the number of functions on the keyboard was rising steadily but increasing keyboard clutter was a liability, HP found a way to control this clutter by placing functions on the fronts of the keys as well as on the key tops. This continued up through the mid 1980s but was inexplicably discontinued with the release of the Pioneer-Series machines in 1988. Suddenly, if more than three functions were required per key, that keyboard got really crowded with function names labeled above and to the side of keys. Despite the implementation of soft-key menus, keyboards got “busier”. Somehow, this change began to be reversed with the 10BII and 17bII+ on the business side and more recently with the 35s on the scientific side By adding this key “plane”, layouts do not seem as intimidating.

Issue 3: A Little Bit About Color Choices for Calculator, Keyboard and Keys

For the most part, from the Corvallis designers, we counted on and received a set of machines which had a consistent look and high key-color to key-label-color contrast. There typically was no issue with reading markings on any keyboard in this era. Then starting with the Singapore group, some things began to change. The HP48G series machines received teal and lavender shifted key functions which were somewhat difficult to tell apart. A second version of the hp32SII was produced with a change in the key colors from the clearly-differentiated Corvallis blue and gold shifts to the same 48G-series teal and lavender. The hp6S was later released by ACO with a blue metallic case and blue shifted function names which became almost invisible under varying lighting conditions. The hp49g, with its odd combination of green, red and blue functions on a light blue case was puzzling. This was followed by the 30S with its set of switchable faceplates to supposedly suit varying student color preferences. Again, traditional users saw more emphasis on style but not necessarily on substance. This trend does seem to be reversing lately, with higher-contrast and more easily readable function and key color choices in the 35s, 50g, 39gs and 40gs.

Issue 4: The Re-definable Top Row of Calculator Keys

Hewlett-Packard began making the top row of calculator keys re-definable on its flagship programmable scientific calculators starting with the HP65 in 1974. With this model, along with the HP67 in 1976 and the HP41 in 1979, the user could mark five (or ten with shifted) functions on the writeable side of a magnetic program card and mount that card either directly above or near the top row of keys in order to

label their functions as assigned by the program. Later, starting with the HP18C business calculator in 1986, HP began an effort to allow the LCD itself to be the identifier of the functions on the top key row. This relationship between the LCD and the top row of keys appeared in several forms throughout the Clamshell machines, the Charlemagne series and in Pioneer 1-line and 2-line LCD machines and continues up to the present day with the 39gs, 40gs and 50g graphing products. It was especially clever how HP Corvallis managed to keep this feature intact with single-line-display HP32S and HP32SII Pioneer units. When a menu is activated, it is displayed in place of the value in the X register and when a menu selection is made by pressing the corresponding top-row key, the menu is removed. The elimination of the need to hunt for specific keys on the keyboard below the top key row is a big advantage over other menu methods such as (1) requiring pressing of up- or down-arrow keys to navigate the entry in the display to the selection of choice, or (2) having to press a number on the keypad corresponding to the selection of choice. In the two-line Pioneer models, the menu labels could be displayed in the bottom row of the LCD while other information remained in the top row. The San Diego group also maintained this feature when repackaging the HP17BII into the hp17bII+ hardware and case.

Later, in 2004, when they refreshed the HP32SII with the release of the hp33s, the top key row and LCD were suddenly and inexplicably decoupled. Despite the fact that the 32SII functionality was maintained (and even enhanced somewhat), the new case and key arrangement did not permit the soft-key menus to be retained. So now, if a user wished to change the current base to OCTAL from within the Base menu, he would either have to press the down-arrow to reach the Octal selection and then press ENTER (which increases the keystroke count unnecessarily), or go down to the keypad and select “3” since this choice was listed in the LCD as the third menu selection. Unfortunately, although with the release of the hp35s last July, the top row of keys was more suitably situated adjacent to the LCD again in order to facilitate a return to the soft-key menu scheme of the Pioneer machines, it was not restored. This could be considered the converse of the proverb regarding those who don’t remember the erroneous ways in past history being doomed to repeat them – this goes something like “those who forget the successes of the past are doomed to abandon them”.

There actually would be a way that the current 35s LCD and key layout could support soft-key menus via a firmware change if HP chose to implement them. Please refer to the paper “Soft-Key Menus for the hp35s” elsewhere in these conference proceedings for some ideas in that realm.

Issue 5: Keyboard Overlays for Fully-Re-Definable Calculator Keyboards

With the introduction of the HP41C in July of 1979, HP took keyboard customizability a large step forward by extending the capability to assign user functions not only to the top row but to any key on the calculator keyboard. After assigning a function to a key, a user could turn on “USER” mode and then identify the customized key function by attaching over top of the keys an overlay which was physically marked with the new function name. Cleverly, the calculator edge around the keyboard had slots cut in it to allow overlay tabs to be snugly set into them. In addition, HP allowed pre-programmed functions provided by some of their own plug-in ROM modules to redefine the HP41 keyboard and they supplied preprinted overlays for those functions. With this technique, the requirement to press the keystrokes required to spell a custom function out letter-by-letter, was supplanted by a key assignment. This USER-mode capability continued with the HP48 S- and G- series machines and with their own overlays and again, slots were in the outer edge of the machines to allow overlay attachment. For those third-party software providers (and also for individual users who wrote programs which assigned many keyboard keys), this was a convenient way to keep keystroke counts to a minimum by redefining multiple key positions.

In 1999 when the hp49g was released, it represented a direct descendant from the HP48 series and retained USER mode to redefine keys, however no provision was made in the plastic case to allow the attachment of keyboard overlays. We have heard HP explain this rationale a few times, whereby since the sales of blank overlays for the HP48 series machines were extremely low, they saw no benefit in continuing the overlay capability. However from my standpoint, if modifications to the calculator case added almost no cost, then had they been present, some outside vendor or enterprising user could potentially manufacture overlays for that small group of people who chose to continue to use them. The attitude of choosing to withdraw support for advanced users despite the cost being minimal is one of concern, but that is a topic for another time.

Issue 6: Full-Keyboard versus Soft-Key Menu-Based Alphanumeric Entry Capability

The HP41 brought many innovations to calculator design, not the least of which was the capability to include alphanumeric strings, prompts and labels in calculator programs. The user interface provided the alphabet spread out on the keyboard so when “ALPHA” mode was entered, the keyboard would be redefined such that each primary key function was an upper-case letter. Thus, with the exception of entering and exiting ALPHA mode, each single keystroke allowed for the addition of a letter to the calculator program or ALPHA display register. In 1988, when the HP42S was released in the Pioneer series as a successor to the HP41 series, the ALPHA mode and alphanumeric text and labels were retained, but the method by which ALPHA entry was achieved was radically changed. Instead of placing the letters on the keys, an ALPHA soft-key menu was presented. Since only the top row of keys get defined for this purpose, the user was faced with a two-level menu scheme whereby the initial menu grouped as many as 5 letter choices on a single menu key. After that menu key was selected, a secondary menu would appear, spreading the 5-or-so keys from the initial menu choice across the row of soft keys. Under this method, each letter required no fewer than two key presses. Although the absence of the alphabetic letters on the keyboard contributed to the reduction in keyboard clutter, the increased number of keystrokes to enter alphabetic information seems to be a regression in user ease.

In 1990 with the release of the HP48SX, the alpha entry was restored to distributed characters over the entire keyboard again and keystroke counts went back down to reasonable levels. This method has been continued to the present day with the hp50g and although the keyboard does have high clutter, it is tolerable.

Issue 7: Base Conversion, Base Arithmetic and Bit Manipulation

Hewlett-Packard’s first foray into the world of base arithmetic happened in 1974 when the HP65 was given decimal-to-octal conversion capability. The pinnacle of this functionality occurred with the release of the HP16C Voyager-Series machine, which was dedicated to base manipulation for computer science applications. Had the demand for such a machine continued to the levels that the HP12C business calculator experienced, perhaps we would still be able to purchase a new 16C to this day. However despite its demise, a subset of base conversion, arithmetic and bit-manipulation functionality survived within a handful of the Pioneer scientifics, the 33s and 35s, the HP48 S- and G-series and 49g/g+ and 50g graphing units. However the depth of capabilities such as double-word arithmetic, bit shifting and rotating and carry and overflow-bit functions were lost. (Rick Grevelle and I produced in 1993 an HP16C Emulator Library for the HP48 S and G series machines, which attained and exceeded the 16C functionality. This utilized a custom keyboard overlay which distributed all the HP16C functions throughout the HP48 keyboard. However, when the 49g came out and there became no way to attach a overlay, we abandoned any attempt to port it further.) Perhaps some day this full capability could be restored to some scientific or graphing machine of the future.

The Prognosis: The Future Is Still Bright

Despite the shortcomings of some of the current line of HP calculators, there is hope for a brighter future. With the release of the hp35s, we were treated to the return of the wide ENTER key, put back in its rightful place at the middle of the calculator rows. The fronts of the keys are being utilized more and more in order to help keep keyboard clutter minimized. Reliability and key feel has been getting better over the past few years as the manufacturer is being educated on how important it is to present a physically superior keyboard. The displays on recent models have been very readable and with higher contrast than those in the past. Color schemes appear to be getting more sensible, with key labels becoming easier to read. The 35s represents a return (somewhat) to home-grown calculator functionality like what has been ongoing with the 50g. Perhaps if the 35s has a market success like it deserves, HP will consider two additional things: (1) adding RPN to an entry-level scientific so as to give new students at least a chance to try RPN for themselves; and (2) following up the 35s with an even more capable RPN-based keystroke programmable in order to continue where the last RPN "king-of-the-hill" – the HP42S, from almost 20 years ago - left off.