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Regarding the performance measurement, the general comments of the participants were that hardware and technology change too fast and that the price of universal performance test equipment and human effort is too high to carry out many controlled experiments. In most cases, people are interested in special applications rather than general principles. It is naive to expect to develop a body of general theory and principles because of the wide variety in applications, individuals, and equipment. Attempts to measure the performance of users and programmers have not been fruitful. However, the participants agreed that the fact that success has not yet been achieved in developing principles of human factors in man-machine interaction has not been a valid reason for discontinuing future effort in this area.

Dr. D. C. Engelbart of Stanford Research Institute described the multiconsole, computer-based, interactive display system which is used in the investigation of principles where interactive computer aids can augment intellectual capability. Rather than measure time and motion, SRI looks at how resources should be employed to derive maximum use where additional funding is available. The importance of the class of user was stressed, as program integrating functions are controllable. Design rationale has to be traded off, as too much individuality can slow down the system's response. There is a need to find a way of translating from one application to another. For long-term users, there should be a rich repertoire of system functions even though each function might take a long time to learn.

The Rand tablet and character recognition was the subject of discussion by Mortin Bernstein of SDC. The objective of the SDC work is to move the man-machine interface closer to the man. The user exercises no control over the timesharing system, but is provided with two levels of response: the first level is the tablet response, the second level is the response from the processor. The Rand tablet works into a PDP1 which feeds a display buffer. The display is projected onto the back of the tablet which is an improvement over separate display and target. SDC has developed a system for recognizing 120 different handwritten symbols. The user can choose the correspondence he desires between his handwritten symbols and those displayed by the system. However, they do not expect their recognition system to replace the typewriter in most applications, but it is effective in applications having omplex formulae that combine alphanumerics and graphics uch as chemical formulae. There is a dictionary capability in ie system for 1500 48-bit words.

The terminal-oriented system experience at MIT was dissed by R. Stotz of Computer Display, Inc. In developing s capability for Computer Aided Design (CAD), all kinds controls were provided on the display console and itches, joy stick, knobs, and light pen were provided. Light tons were not used to ineract with systems software; users ded to prefer systems-supported functions that gave them est job turnaround. Function switches were rarely used. oy stick was used for rotations. The keyboard was used tinuously. The users were more interested in getting a job than in developing tools. People use facilities that are at hand (teletype) rather than using better graphical inals that are not located near them. Meister stated that basic objective of human factors workers is to optimize nan-machine system rather than optimize the machine ie man. There was some opposition to this point of view.

lig-deeper session was held in the evening to discuss andardization of terminal devices, communication prob- associated with terminal-oriented systems and human design of terminal devices. An APL demonstration was and getting access to the system as well as the general conventions of the system, its working files, program libraries, and various functions and systems responses were shown. Mr. Turk went into the detailed techniques of text editing, vector handling, and string manipulation and showed participants APL's capabilities.

## SESSION III *Impacts of Terminals on System Software*

David Farber of Rand Corporation opened the second day by briefly reviewing the state-of-the-art of software for terminal-oriented systems. He classified software into two broad categories: those specifically designed for a terminal-oriented system and those originally designed for batch processing and later modified for terminal-oriented application. In either case, an evolutionary process is involved in order to provide sufficient flexibility to cope with impacts of new terminal devices.

Joseph Ossanna of Bell Telephone Labs described the use of MULTICS using a GE 645, which is now in the implementation stage by Bell Systems programmers. Plans call for 24-hour service; the system is currently used 3 to 4 hours. Current timesharing algorithms are round-robin, but more sophisticated scheduling algorithms are planned. By using 256K program segments, dynamic linking is utilized to keep down overhead. By using a technique that allows linkage of names to processors as well as files, introduction of new processes does not slow down the system. For instance, the current terminals linked to the system, 1050's, 274's, and TT37's, are all interfaced using common, table-driven codes despite their great differences. While the GE 645 CPU uses "GIOC" 100%, BCPL, BON, SNOBOL, and basic assembly language are now available to users. EPL is slated for later use.

George Wiederhold of Stanford University addressed the application of a terminal-oriented system for medical application. He stressed the need for large files, system reliability, and response times. Their 360/50 can accommodate 30 terminals of the 2741 type. Two million bytes of 8 $\mu$sec memory are available, 45 active terminals are planned. Secretaries are the main users, 200 current projects are supported by two systems programmers. The users have access via a PL1 subset which contains FORTRAN-like capability and allows the manipulation of variable length character strings. A light on the console shows CPU response to the user with a steady red indicating critical priority use of the system, e.g., cardiac cases. Lab devices can be supported, analog devices are treated as files by the system after the user describes data rates. An 1800 currently multiplexes all devices such as CALCOMP plotters and pen drives. A PDP8 will be interfaced into the system. As the lab environment differs from the commercial world in that extreme reliability is needed, it is of interest to report on ACME systems failures. Current failure rates are 3 to 4 a week, with a 4 to 1 hardware/software ratio. Parity and channel errors are the major hardware problems; about 30% of all hardware failures are caused by transmission control unit errors. The majority of software errors lies in the operating system. With batch runs relegated to second and third shifts, ACME is currently involved in pilot projects as opposed to a production environment.

Irwin D. Greenwald of Rand Corporation described the tools provided for scientific computing at Rand in support of graphics research. While graphics are going to be cheaper, reliability and quality are not quite satisfactory. With a current display rate of 30 FPS, scrolling [illegible] described and a [illegible]