

High Tech Meets High Touch: Electronic Creation of Individual Production Records in the Field

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Most farm businesses--even those with sophisticated techniques for tracking cultivation practices, finished products, and financial transactions--still rely on stone-age methods to record work hours and production of field employees. Typical procedures require that each day foremen write workers' names, the times of their starting and stopping work, and, in piecework systems, the numbers of units they produce. This ritual is pursued at considerable cost in time for the foremen themselves, the clerical staff who have to deal with the copious hand-written documents that come in from the field, often dog-eared or patently illegible, and all parties who get involved in rectifying paychecks that come out wrong.

It is not unusual for 10-15% of production employees on a farm to question the accuracy of their paychecks in a given pay period. Errors at any step of data handling, from the field to the payroll generator, may cause miscalculation of earnings based on either output (i.e., piece rate) or hours worked. Problems with output-based checks are usually caused by inaccurate crediting of units during the workday or faulty key strokes later in the office. Incorrect hourly-based paychecks often trace to foremen simply neglecting to list a worker's name on one or more daily crew reports during the pay period.

Equipment that is easy to use and affordable to a broad range of businesses can now create reliable, paperless time and production records in the field. Farm managers can turn this information directly into computer-readable files from which paychecks, reports about payroll, and various other outputs are readily generated.

Modern Recording of Field Events

A system that takes advantage of this equipment is now being used in a few California agricultural firms and pending adoption by several others. It records workers' presence and output, builds this information into a computer data base, and yields reports from it, most importantly including a file on magnetic media formatted for direct input to payroll services or software.

The basic act of collecting source data in this system is simply touching a small sensor unit, a "touch probe," to a smaller metallic disk, a "touch button," that causes a memory in the sensor unit to register the occurrence of an event, such as the receipt or stacking of a packed container. The most straightforward application of this technology is to count units for which workers are to be paid on a piece rate basis, substituting for the traditional method of hole-punching a card carried by the worker. But a probe-to-button touch can also be used to record other significant events, such as the beginning or end of a work period.

Production units and work hours can both be tracked for the same workers as long as there is a means to distinguish "production touches" from "time touches." A computer that processes records from the probe memory may be programmed to recognize the meaning of various touch sequences. So the single touch of a worker's button could be used to count a unit produced, while a prescribed sequence of touches could signify start or stop time. To record an individual's coming or going, for example, the foreman might be instructed to touch the probe first to his own button and then immediately to the worker's. A double touch of the foreman's own button could be used to quickly mark the beginning or end of work time for an entire crew.

Integral elements of the data system are:

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- Touch-button Badge. A touch button is a silicon memory chip housed in a stainless steel disk, about the same diameter as and slightly thicker than a dime. The chip carries a unique machine-readable identification code. Since the enclosure keeps the chip free of damage from impact, moisture, heat, dust, and other outdoor environmental stresses, touch buttons are more durable and reliably read than bar codes or magnetic stripes. Up to four buttons, corresponding to different types of product or tasks that might be paid at different rates, can be affixed to one side of a hard plastic badge, about 1" x 3", with a safety pin on the back side.
- Touch-probe. The heart of this system, the probe unit is a steel-cased device the size of a small flashlight, (4.5" x 1.5" x .8"). It contains an internal time and date clock, a data storage medium (128K capacity), a sensor contact at one end (tapered), a sound and light emitting diode to signal when the sensor touches a button, and a 9-volt battery with lithium backup.
- Uploader. A smart electronic "funnel" for transmitting data from the touch-probe to a computer, this unit has the shape of a small box (about 4" x 4" x 2") with a recessed socket on top into which the probe is inserted. It connects to the computer by a standard serial interface cable.
- Computer. Any MS-DOS (PC compatible) computer can be used to receive and process uploaded data. A laptop is most flexible, enabling upload and data examination in the field or office.
- Computer Program. Proprietary software prompts the user to pre-specify the "meaning" of each (uniquely coded) touch button, in terms of the employee to which it is assigned and the event (or particular product) that is to trigger its touch by the sensor. The software maintains uploaded data records in a file sortable and reportable by chronology, employee, and type of event. Potential for customizing reports is virtually unlimited.
- Printers. Any printer may be used for the programmed reports. A small high-speed receipt printer can be used in the field to issue individual receipts, at the rate of twenty-two per minute, that provide workers with daily documentation to take home.

Setting for a Demonstration

This system was demonstrated in a strawberry harvesting crew on the south central coast during May 1993. The crew is one of many within a firm that employs an average total of 400 field workers, some 75-80% of them paid on an hourly basis, primarily in vegetable harvest. Workers continuously employed by the company are provided health insurance and other non mandatory benefits.

Data entry for payroll (the entry file becomes input to a payroll service firm) in the firm occupies the equivalent of two full time clerks. These office employees are also responsible for preparing customer invoices, and the burden of their payroll workload has caused many billing delays. Most of a 12' x 15' room in the company office is devoted to storage of paper payroll records.

The strawberry crew was picking Chandler and Selva varieties in a semiweekly rotation over 35 acres. All 39 pickers in the crew, plus a small cadre of available substitutes, had been known and recruited by the ranch manager or crew foreman. Their season started in April and lasted through September, though some workers were laid off when fruit production declined in July. They were paid on a straight piece rate basis, \$1.30 per tray (containing 12 baskets). Managers of the firm felt that they had earned the trust of production employees, and field communications appeared to flow easily among supervisors and pickers.

In the harvest operation pickers carry their packed cartons, usually two at a time (loads of more than two are disallowed for safety reasons), to either of two staging areas at the edge of the field. They stack the cartons, write a personal identification number on each, get them checked and credited by the foreman or assistant ("punchadora"), and then pick up empty cartons with baskets to take into the row for another cycle. Because pay is linked directly to production, pickers try to minimize the uncompensated time they spend in the checking-crediting process.

The Field Trial

Crew members were socializing and preparing for work as the general manager, company safety supervisor, and data system developer arrived at the worksite in early morning. Supervisory staff who were already present included the ranch manager, crew foreman, and assistant foreman. None of the pickers or supervisors had been informed of this trial ahead of time.

After first explaining the system to supervisors, the general manager and system developer presented it to the assembled crew in a discussion lasting about 15 minutes. The equipment was shown, and all questions were entertained. Most of the workers seemed interested and open to the new system, if not wholly enthusiastic about it. A few appeared either confused or skeptical, staying in back of the group with impassive expressions.

Questions from the crew were mostly about the touch button badge. What if it gets lost? Is there a battery in it? Are those disks (the buttons) really pills for back pain? The manager offered to keep parallel records through the usual punch card procedure along with the electronic counts, but clear consensus of the crew was to try the new method alone, as long as there would be some form of written record to keep at the end of the day.

A personalized touch-button badge had been prepared for each picker named on a crew list from the previous week, and the computer program had been set up to associate individual names with the codes uniquely marking their touch buttons. Several badges not preassigned to individuals were also available. Supervisors distributed the personalized badges and helped pickers pin them on to shirt or jacket sleeves. Several pairs of workers helped each other. Badges and people did not correspond one-to-one. Fifteen named badges were still unclaimed from the board, and eight pickers for whom personalized badges had not been prepared were given no-name badges on the spot.

When all questions had been answered and all badges pinned, the pickers fanned out into rows to start their work. The system developer initially carried the probe and dispensed "touches" upon the checker approving boxes delivered, and the assistant foreman took over this function after about ten minutes. Harvest work, checking, and electronic counting proceeded smoothly. From all outward indications, the system was functioning and acceptable to the crew.

As the morning wore on, the touch system appeared to be decidedly quicker and less cumbersome than card punching. The assistant foreman, wearing the probe on a long string around his neck, commented on the simplicity of this method for him. Pickers got their credits by merely turning sideways to make their badges accessible. Card punching, in contrast, had required a series of motions by both picker and checker. The picker had to pull a card from pocket or hat, present it to the checker, receive the card in return, and put it back in his or her clothing. The checker had to pull the puncher from his pocket with one hand, receive the card in the other hand, punch the card, and return the card to worker and puncher to pocket.

At lunch break the uploader, adapter, computer, and printer were placed for all to see on the lowered tailgate of a pickup truck. The touch-probe was mounted in the uploader, which connected to the laptop computer. Within a couple of minutes, the uploader copied all data from the probe into a binary file on the computer, where it was at once converted to ASCII format. The analysis program then generated a complete log of events (touches) and displayed it on screen.

A line corresponding to each touch specified its time, employee name and number, and nature of event (pick). Pairs of touches of the same button on a badge, in rapid succession, were treated as a single event, the second touch considered an erroneous repeat. As programmed in advance, both touches in such pairs were listed in the chronological log but only one was counted in employee and crew production totals. On command, the computer displayed a full report of activity for a few employees and then a summary listing of production totals for every individual in the crew.

One after another the workers checked their lines on the report against what they knew they had accomplished that morning. Not a single claim of discrepancy arose. A few of the pickers expressed concern, however, about not having anything tangible to keep as proof of their own production (the receipt printer had not been brought to this trial). They were satisfied by the manager's assurance that

each crew member would be given a copy of the full crew report, and that if the system were adopted for regular use, an individual receipt would be printed for every picker at the end of each day.

The most striking reaction to this display was that of the ranch manager, who held forth in a series of animated conversations with crew members about this system and its wonders. He told an observer how much this system could help cut down daily paperwork and the paycheck complaints that sometimes came all the way to him. The pickers were amazed at the magic show and pleased with the accuracy of the report. One woman in the crew said that she was very glad to not have to keep a punch card tucked in her scarf, handle it each time out of the row, and go through the day in fear of losing it. A man said that this definitely was a better way of getting his count correct.

The harvest work resumed after lunch. Immediately upon its completion, new data from the touch-probe were uploaded and added to the morning records in the computer file. Two copies of the full-day report were printed and passed among the workers. Again all agreed with the listed production totals.

Assessing Benefits and Concerns

Word from the cooler in late afternoon was that 1,039 packed cartons of strawberries had been received from this crew. The sum of cartons credited to individual workers in the field had been 1,038. This .1% discrepancy was the smallest of any day in the company's year-old strawberry operation. On most days the difference had been 5-10 cartons. In a repeat trial three weeks later, the cooler counted but 2 cartons more than the total (some 1,400) credited to pickers in the field, the second smallest discrepancy on record.

The day after the initial trial, the crew was back to punch cards for tracking production. While showing two packed trays to the foreman, a picker pulled a card from his pocket with one hand, smiled, and tapped his upper arm twice where the badge had been pinned the day before. The foreman summarized what this picker and others had already told him they missed about the electronic system: no hassle, less motion, less worry.

Four other workers, two men and two women, all said that they much preferred the touch system, but one pointed out the drawback that it provided no convenient running reference, like the card, for checking one's mental count of units credited before the end of the day. Another picker observed that while he himself thought the new system was much better, a few members of the crew definitely did not like it.

Although a more conclusive assessment of what the electronic data system holds for farm employers and workers should be based on observations over a much longer period, this brief demonstration strongly suggested several attractive features and benefits:

- The system is fast to learn, requiring no special skill or literacy to comprehend or operate.
- It makes data recording and storage easy. The foreman or checker needs only one hand to position the probe, and pickers have no need to handle or store cards during the work day.
- Cost of the daily punch cards is saved.
- The listing of workers and their production totals is automatic and timely. The supervisory burdens of completing a written report with worker names and total units produced, and of preserving this report in legible form, are eliminated.
- Daily receipts for workers are clear and inherently consistent with the data used for payroll.
- Entry of production and time data into the payroll system is electronic, requiring no entry via keyboard and thus reducing clerical expense, data entry errors, and risk of office staff members developing carpal-tunnel syndrome.

- Improved accuracy reduces complaints about paychecks and hence the drain on supervisory time to resolve them.
- Time-stamped documentation of daily production by each individual worker aids in resolving paycheck questions that do arise.
- Archival storage of payroll data is much more compact and cheaper on electronic media than paper.
- Personalized badges may enhance employee esteem and sense of belonging in the company.
- Badges left on board after start of workday give foreman a quick visual indication of absenteeism.

To be weighed against these advantages is the cost of system equipment and software, conservatively estimated at less than \$12,000 for an operation with 200 workers in six crews, and the lack of a tangible running record for workers to reference. A more subtle consideration is the risk of workers suspecting and reacting to such newfangled procedures as part of a management scheme to cheat or mistreat them. Along related lines, the use of a high-tech record system in low-tech production operations (intensive hand labor) may contribute to workers' sense of alienation from their employer.

Conclusion

Data handling entails significant administrative expense, and it affects employee relations overall as well as the coordination of field work with other functions in a farm business. The observed system for electronically creating production and work time data in the field represents a class of innovation that has extremely broad applicability in agriculture. It alters the technology of not the production work itself but rather the processing of essential information about that work.

This system and others like it offer capacity to generate higher quality operational data for more timely use at lower cost than traditional methods. Carefully designed and introduced into production firms, they are likely to enhance business efficiency and competitive position. Experiences of early adopters should be monitored to gain knowledge that will guide both system developers and farm managers who consider using this information technology in various commodities and production circumstances.

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