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Prepared discussion contributions

Some Results from the Computer Installation at Empire Paper Mills

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MY PURPOSE is to give a brief description of what we have achieved with our computer installation and to draw some comparisons in philosophy with the paper by Cyprus & Attwood.

The papermachine makes fine writing and printing papers at speeds up to 1 000 ft/min. Most of the papers are made with a dandy roll and a fair percentage are watermarked. The computer is a GEC Series 90, Model 2, with a 16 K, 12 bit word core store. The addition time is 3·5μs. There is no back-up store, but we have recently decided to double the core size. We use DDC on practically all loops.

The primary function of the installation is to control the papermachine from head box to reel-up, but future developments will take us back into the stock preparation, on into the finishing area.

The computer was installed in October 1967. By January 1968, thick stock flow was under computer control. By October 1968, substance was under continuous computer control and has been ever since. We studied the process using pseudo-random binary sequence trials and found that the system could be represented by a time lag and a first order exponential rise. Before the computer installation, the substance had a coefficient of variation of 3·06 per cent. Over the period April-June this year, this variation had been reduced to 1·89 per cent. This variation includes both between makings and within makings. The average for within makings is 1·35 per cent and on some orders is down to 0·5 per cent. The main factors contributing to the rest of the variation is partly between making variations and partly that the machineman will alter the computer set point on the basis of his weighed samples. Until we can use the reel weighing mechanism to update the substance gauge calibration, we are not in a strong position to stop this practice.

One of the major incentives to come out of the feasibility study was moisture

control. This was tried in October 1968 and the moisture variations was reduced to $\pm\frac{1}{2}$ point. On many occasions during our experiments, the machine speed was lower than was necessary, not because of papermaking problems or lack of drying capacity. As a result of this, we tried a technique of controlling the machine speed to the maximum drying capacity. We were able to achieve appreciable increases in speed—in one case, 100 ft/min. Unfortunately, we have been unable to continue with moisture control, because of a series of problems that developed with the moisture meter. These we think are now cured and we are back on moisture control.

We also use the computer to control grade changes. Essentially, we follow the practice that the machineman used to do. The machineman feeds the computer with the data of new substance and speed required; the computer calculates the new required settings based on the existing running conditions. When he is ready, the machineman presses the *enter* button and the machine ramps to the new set points. We are limited in the slope of the ramp by the rate at which the machine changes speed. On our machine, the number of grade changes to which this is applicable is limited, as the majority involve dandy cleaning, dandy change, backwater change or wash-up. As a result, we see no need in practice for any greater sophistication.

The control room is mounted so that it overlooks the dry line. All the controls and information that the machineman may require is in this room. From here, he operates via the computer or, if necessary, via the standby controls. Although all the information is in the control room, the machineman in fact spends most of his time on the machine floor. He is completely confident that the computer will keep the machine under control in his absence.

After some initial instrument failures, we have gone to considerable trouble to check the inputs. Every input that is used for control is checked by the computer to make sure that it is reasonable—that the fuse has not blown or the reading is not too different from the previous one. If the computer finds that the input is outside set limits, then the appropriate loop is put to manual and an alarm sounded. The other loops are unaffected. The alarm continues until some corrective action is taken. By using this approach, the computer has been in continuous control of the machine, despite occasional failures elsewhere.

One of the factors that is influencing the current work is the supervisory structure in the mill. This has been traditionally a horizontal structure and so the common supervisor over the beaterman, machineman, dryerman and reelerman is the chief papermaker. We have always had excellent co-operation from the machineman, but it is not so good from the others. This is almost entirely because they tend to feel isolated. The facilities that they have to

communicate with the computer have not turned out to be sufficient. As a result, we are having to increase the facilities available at the outstations beyond what was initially thought necessary. In retrospect, a more vertical structure would have made the computer operation much easier to put across. It has since been considered, but the problems of implementing it appear to outweigh the advantages.

Looking back over the project, one of the most prominent features is the role of instrumentation. We have had a number of problems with our instruments, which have caused serious delays in the progress of the project. The computer arrived while some of the instruments were being installed. Inevitably, the delays caused by the instruments gave a bad name to the computer, particularly to those people who watched the project critically and from a distance. Considerable time is necessary to ensure that the instruments are reliable before any attempt is made to use them with the computer. Without a computer, reliability is an abstract idea; with a computer, reliability is measured in sleepless nights and long weekends.

In conclusion, our computer project has had considerable successes and some great disappointments. Already we have beaten our target for substance control and with obvious potential for further advance. Moisture control has been a problem of instrumentation, but what we have seen is promising. Thick and thin stock and flow box level are under DDC. We have facilities for control of efflux ratio, but there is no incentive at present. Clay addition can be put under DDC and, when the new ash gauge is calibrated, sheet ash content will be controlled. We are more than ever convinced of the benefits of our computer.

Discussion

Mr R. G. Nagro May I congratulate you on your paper and your computer system. You stated some estimates of the expected system payout. After having had some working experience, would you like to modify those or support them or is it still too early to tell?

Mr H. D. Cyprus I take it you are referring to the estimates shown in Fig. 1. I would not change them, except possibly to raise them somewhat. We have certainly not yet achieved those returns. This is partly reflected in the troubles we had last year; it also affects our lack of expertise, which is still being developed. I cannot see why we should not achieve those levels.

Harking back to my comments on performance quantity, I am not convinced we did not do ourselves, the management and the project a disservice by looking at it in this light—by isolating the return on improved regulation of basis weight, proportions of the constituents, etc., yet I cannot think of an alternative.

Mr J. Mardon My first point on Mr Cyprus's paper is my great difficulty in accepting the idea that one first chooses a computer, then undertakes the planning preparation phase. This seems to me a negation of what I might term the classical approach. First of all, the planning phase; then one should choose the pieces of equipment suitable for the specification when it is drawn up. I would appreciate Mr Cyprus's comments on that.

The second point is to say to Mr Nagro that the idea of having on-line access to the computer without in any way impairing its functionality for control has been taken into account in the design of the Bailey 855.

Mr Cyprus There seems to be a measure of misunderstanding. The planning and preparation phase that I referred to under the heading phase 0 was in fact detailed preparations and detailed planning in line with the decision to go ahead with this particular system. Of course, the company, working with more than one manufacturer, did a preliminary preparation and planning phase. This went on for some time before the decision to buy this particular system and it decided for us the general detail, for example, whether or not to buy a computer, whether an analog or digital, whether small, large or medium sized, etc. Phase 0 was detailed planning and detailed preparation, which

must be done after deciding what equipment to use. Otherwise, I agree with your comments.

Mr W. D. Hoath Mr Cyprus mentioned that they had their own learning to go through in computer installation. What were the problems experienced? Were they hardware, software and how well did they keep within their budget costs? On the standby equipment, he is having to cope with several manufacturers. Was this a problem in itself?

Mr Cyprus With respect, I will not go into the detail on the first part of the question, because the answer lies fully in the paper. The troubles we had did not affect our costing, but I think the reason for this is maybe the way we organised the budget initially.

We had no great embarrassment because of different manufacturers. We know our instrument suppliers well and there were no delays through them. Although our interface and standby equipment was manufactured by one firm, it came as part of the supply from another firm in a satisfactorily phased manner. To be fair, the hardware was delivered late and therefore this may well have hidden problems that we might otherwise have had.

Mr M. I. MacLaurin Some of you may have heard me speak on the subject of computer project assessment earlier this year in New York.* Since that time, we have gained further experience in this area and, were I to speak again on the subject, I would be less assured of the practicability of the method I described, despite its theoretical merit.

The basic problem is not so much in comparing how well the papermachine performs now compared with the pre-computer period, but more in identifying how much of this improvement may properly be attributed to the effect of the computer.

Mr Cyprus I agree totally with you. It seems to me pointless to compare the 1965 performance (when we did our initial study) with running today. As I have suggested, this has no meaning. We must define a parameter, the performance quantity (which takes into account all those factors influencing performance) and monitor it continuously. Normally, it should show a logarithmic rise and a step to a higher level if some factor contributes significantly to the well being of the process. We have developed this growth curve for No. 16 machine for the last six years or so and will maintain it, hoping to see an effect attributable to the computer.

An alternative might be to take the computer off for a month, then put it back on, hoping to show the improvement. I consider this to be an impracticable proposition.

* *Tappi*, 1969, **52** (8), 1 480—1 483