Getting the Most from your High-Speed Inserter: The 4 Primary Productivity Factors

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Summary: In the never ending search for increased productivity, production mail facilities have made significant investments in high speed inserting equipment; unfortunately too often the expected higher yield rates have not been achieved due to the relationship between accelerated machine speed and increased machine downtime. An understanding of the 4 primary inserter productivity factors operating in most production mail environments is an important first step towards dramatic improvements in run time ratios and overall cost savings from decreased overtime.

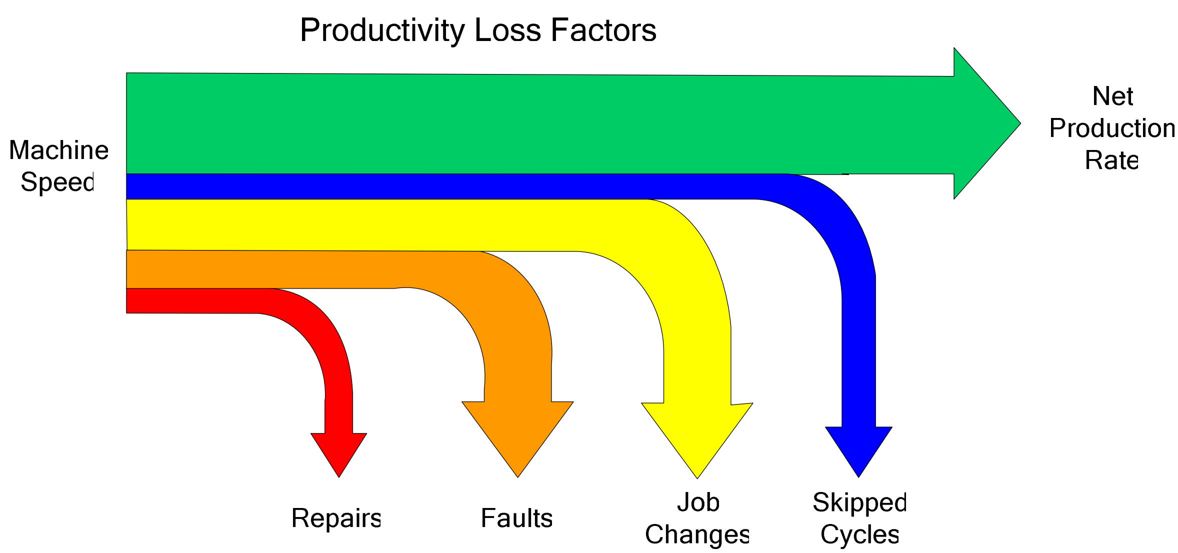
You conducted research, did detailed analysis and as a result you recommended that your company make a significant investment in new high-speed inserting equipment. This was probably one of the biggest and potentially one of the most risky decisions of your career. Now the equipment has been delivered, installation and testing are complete, and you're ready to run your new high-speed equipment and reap the benefits of maximum productivity, Right?

Unfortunately, even though a machine is scheduled for production and operators and material are available it is not always producing; time is siphoned off by a number of loss factors. There is no one factor that is automatically the greatest culprit; every production environment and mailing application is different. Accurately measuring these factors and understanding how they impact production can help managers and operators create and manage a process to dramatically improve productivity.

The 4 primary machine-related[1] causes of reduced production are:

- Faults
- Job changes
- Repairs
- Cycle utilization

[1] These factors only occur when the inserter is actually being used in production. They don't account for work flow and scheduling related down time such as: operator breaks, scheduled maintenance, training time, application and system testing, and times that work is not available.



Job Changes, Faults, Repairs and Skipped Cycles are impacting the productivity of your high-speed inserter on a daily basis. To understand their effects, let's examine them individually.

1. Job Changes

The first challenge for getting production out of an inserter is to get a job loaded onto the machine. Although this should be simple, it actually involves a number of tasks, which can collectively add up to a significant amount of time. And once the job has been inserted it has to be closed out, again providing the opportunity for small tasks to eat up time.

To simplify the analysis, the job load and closeout times are often combined into a single *job change time*. The tasks required to change jobs include:

- Cleaning out the machine at the end of a job
- Performing required end-of-job quality inspections
- Completing paperwork
- Moving completed job material away from the machine
- Moving the new job's material to the machine
- Making any needed changes to the machine's setup for the new job
- Performing the necessary job load functions at the inserter's user interface

- Loading the new job material into the machine
- Setting meter postage and/or changing meter slugs
- Performing setup checks, such as checking scanner alignment
- Completing required start-of-job quality inspections.

The impact these tasks will have on time loss varies widely depending on the type of application, how materials are supplied (i.e. on a roll, on carts, or in boxes), and on what supporting personnel are available to off-load this work from the machine operator.

The most important thing to remember when considering the impact job change time has on productivity is that the impact is governed by its relationship to the average size of a job. Obviously, the larger the average job size, the less impact job change time will have on production. As machines get faster, the more significant job change time becomes as a productivity factor since the time to actually run the job shrinks. It is not uncommon for job change time to exceed actual running time after a site upgrades to higher performance machines.

It is important to get hard data on job size distribution; often the presence of a few very large jobs can give the impression that the average job size is larger than it actually is. Those little odds-and-ends jobs can really add up.

Many factors go into determining the job size, many of which originate far from the inserting operation:

- **Business Application Requirements:** Statement mailings are rooted in business applications which often require that the total mailing be broken up in various ways, such as by statement due date.
- **Document Design:** The document design may require statements to be printed on different base stocks or to be matched up with secondary document streams, preventing smaller jobs from being merged.
- **Service Level Agreements (SLAs):** Short time windows between accounting cutoff time and postal entry often make it impossible to aggregate smaller jobs.
- **Postal Optimization:** Presort, automation, and other postal mail make-up regulations can put constraints on job contents, especially when combined with business and SLA requirements.
- **Insert Plans:** Mailings that utilize a number of different inserts may need to be broken up if the total family of inserts being selected from is greater than the capacity of the inserter.
- **Work Tracking:** Breaking down the work into smaller units can make it easier to measure progress through the day, especially if tracking is done manually. The completion of these modular jobs occurs frequently throughout the shift providing good milestones, but at the cost of additional overhead.
- **Quality Control:** Quality sampling is often easier to do on smaller jobs, especially for high value applications. Errors can be surfaced sooner and less

material may have to be thrown out. Again this is at the cost of maximum machine productivity.

- **Material Handling:** The material for smaller jobs is easier to move. Large jobs may require special handling equipment such as carts or roll transporters.

These factors tend to combine to force jobs to be much smaller than is optimal for inserting. In addition, because the requirements often originate far from the mailing operation and even outside the enterprise (such as postal requirements) they can be difficult to change.

Despite these difficulties, it is worthwhile to take a close look at job sizes in a mailing operation. There are ways to overcome many of these problems, such as improving real-time information systems, applying advanced printing technologies, and application re-engineering. These changes generally require carefully planning and selling to the constituent organizations, however their bottom line cost advantages can be significant.

2. Faults

Ideally, once an operator has loaded a job onto an inserter and pressed the start button, the machine runs continuously until the job is completed. In the real world this almost never happens. Inserters stop for all sorts of reasons: paper jams, scanning errors, a feeder running out of material, breaks in the input web, a meter running out of postage, someone opening an interlocked cover, and many others. A fault is defined as anytime the machine stops, requiring operator intervention (other than when the job is completed, or in special cases where there are application defined stops such as for special handling of a piece).

Two factors are critical when measuring the impact of machine faults: how often the machine stops, measured in machine cycles (Mean Cycles Between Faults or MCBF), and how quickly the operator corrects the problem and restarts the machine, measured in minutes (Mean Time to Clear Fault or MTCF). How often the machine stops is measured in cycles rather than minutes because a cycle is a better measure of the chance for an error. Every time a machine cycles, there is a probability that an error will occur.

As technology has improved, inserters have become faster. However, the operator's response time to a fault has roughly remained the same. When a fault occurs an operator must still recognize the fact, stop what he is doing, move to the location of the error, and correct the problem. The fact that the machine is faster doesn't speed up the operator, in fact it may slow the operator down if the machine is larger or has more complex mechanisms or covers. This means that if the MTCF (Mean Time to Clear Faults) remains constant, then for a high speed machine to be cost effective, its cycles between faults (MCBF) must increase. Otherwise a point of diminishing returns will quickly be reached.

Analysis from a large number of different production mail sites indicates that the average time for an operator to clear a fault is approximately 3 minutes. Although this may vary based on the type of machine and application, and the skill level, tasking, and motivation of the operator, the time is remarkably consistent. For an older machine, operating at 5,000 pieces/hour, with an MCBF of 1,000 cycles, the machine will stop on average 5 times for a hour of production time, adding another 15 minutes, and yielding a net production rate of 4,000 pieces per hour (neglecting the other loss factors). If a new high speed machine, operating at 20,000 pieces per hour, had the same fault rate, fault time would add an additional 60 minutes to the production time, yielding a net production rate of 10,000 pieces per hour. The new machine is cycling 4 times faster than the old, but produces at barely more than twice the rate! To achieve the same relative level of efficiency, the high speed machine would need a MCBF of 4000.

Understanding the impact of fault time on an inserter is an important step towards improving productivity. It is important to both reduce the occurrences of faults and strive to reduce the time required to correct them. Digging down to the root cause of the faults is critical. There are several contributing factors:

- The design of the machine.
- How well the machine is maintained.
- The quality of the materials (inserts, paper, envelopes).
- Operator skill level.
- Job and materials preparation.

Although the machine design or maintenance is often given most of the blame, the other factors can be as important if not more so. The fault causing factors often intertwine with each other, obscuring a clear direction for improvement. It's important to look at all of the variables, and not assume that the solution rests with addressing a single cause. Often the cure rests in a clever mix of solutions.

The search for a root cause of fault time is best started by building a detailed list of the faults occurring on the machine then categorizing them by type and impact (how much time is required to correct them). Building this list is not always easy. It requires capturing a large amount of data and understanding the true causes of the fault (for example a jam at the insert engine can often actually be caused by a module much further up stream, such as the folder). Careful selection of tools and analysis processes is important to a successful improvement program.

3. Repairs

When the operator is unable to restart the machine, and calls for help from a service technician, it is considered a repair. Repairs do not include scheduled service, such as a regular preventive maintenance program. Even if the problem is minor, these stops take longer than a fault stop because time is required for the service technician to respond. Since most production mail sites utilize some type of on-site service support, this time is usually less than an hour. If off-site service is used, the times would obviously be much longer to allow for travel.

As with faults, service problems can have a number of root causes: certainly the quality of the machine and maintenance are critical, as are operator skill and material quality. Application design issues can be a big contributor to repair frequency. For example poorly designed or printed scan codes will necessitate frequent scanner adjustments. A high frequency of service issues can also result in a negative spiral situation: the more often the operator has to call for service help, the less confidence they have in the machine and their ability to operate it, leading to more service calls and increased down time.

Identifying and correcting the root-cause of chronic repair issues can significantly reduce down time. Having readily accessible on-site service personnel is a great advantage, but it often becomes a crutch by allowing problems to continue without permanent solutions. Even quick-to-resolve repairs can be expensive if they occur repeatedly; any stop is expensive in a high-speed environment. It is important to have a process in place to measure and categorize problems and implement corrections. The modification of a machine, redesign of a process, or improvement in operator training can yield great reduction in the frequency and duration of repairs.

4. Skipped Cycles

Once the machine is loaded, faults cleared, and repairs made, the machine should be producing. There is, however an often misunderstood factor that can have a serious effect on productivity. It is the machine's ability to utilize all of its cycles, measured as "Cycle Efficiency".

In modern mailing applications it is rare to find an application that puts a single page, or even a fixed number of pages, into the envelope. Normally the primary statement contains a variable number of pages. Since there are more statement pages than envelopes, the inserter's statement (or input) feeder is normally designed to operate significantly faster than the envelope insert engine. However, this increased speed may not be sufficient if the average statement page count is high enough. For example a typical input feed might operate at 2 or 3 times the speed of the insert engine, but it is not unusual to find statement mailings with 4, 5, or more pages per mail piece. When the number of pages in a statement exceeds that which the input can feed in a single machine cycle the inserter has to skip a cycle, leaving an empty spot to flow through the system and losing that cycle of production.

Inserter manufacturers often include buffering devices to try to eliminate skipped cycles, but these devices are usually only effective in limited situations, such as when a single high page count statement occurs in the middle of a large group of small statements.[2] Skipped cycles can occur even if the average page count for a mailing is below the theoretical single cycle capability of the input feeder. All that is required is for there to be clusters of higher page count statements, something that can easily occur in zip sorted mailings where customers with similar demographics tend to be grouped together.

[2] Inserter buffers are often advertised as having 4, 6, or more stages implying that they will smooth out high page count statement clusters of the same size. However, most of the stages are actually used to overcome the delay caused by the length of the statement feeding section (feeder, transport, accumulator, folder, etc) resulting in only 1 or 2 stages available to smooth out high page count clusters.

Cycle skipping is a big improvement over older technology that required the inserter to stop and wait for high page count statements, because it eliminates the disruption and wear caused by the frequent stops and starts. Cycle skipping can be counter productive however. A machine that frequently skips cycles (averages 10% or more skipped cycles) may actually produce more if it is slowed down. This is because a skipped cycle causes a whole cycle to be lost, even though the input feeder might have only needed a small fraction of a cycle time to finish feeding the statement. The best speed for an inserter is at the point that results in very few skipped cycles.

Conclusion

The need to enhance productivity is a given in today's production mail environment. In an ideal world, maximizing productivity would simply be a matter of turning the machine on to maximum speed. In reality, it requires a thoughtful analysis of the 4 primary machine-related productivity factors. The time invested in examining the effect these 4 factors are having on your production mail site will pay off markedly by bringing you closer to that elusive goal: Maximum productivity.

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Lone Oak Technologies, LLC is a production mail focused software technology firm offering a suite of state-of-the-art products aimed at productivity management, mailing data automation, and production modeling and simulation.

[3] *Direct Connect Inserter Control System* is a trademark of Pitney Bowes, Inc.