Teller Scanner Performance and Scanner Design: Camera Position Relative to the Feeder

A White Paper developed by the CIT Inc. Engineering Team

Preface

From time to time the engineering division of manufacturing companies reaches product defining decisions. This is normally the combination of persistence, intellect and an intimate relationship with market requirements. Their ability to step outside the 'norm' and convert science and technology into cost effective products is their other attribute.

We are fortunate at CIT Inc. to have such a team and this white paper is a great reflection of their abilities. I trust that their knowledge and insight contained in this document provides you the reader with an insight into a productivity issue that is inherent in the design and manufacture of certain Distributed Check Image Capture devices.

Chief Executive Officer

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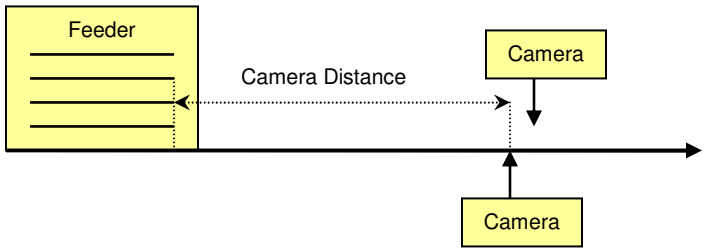
When you have accumulated enough experience designing and engineering scanning products for optimal performance, one of the many things you firmly come to understand is that small insights and/or small oversights are what distinguish an outstanding product from a mediocre one. Here is a prime example that qualifies as an insight if you have it while designing a Teller Scanner and a significant oversight if you discover it after your design is done[1].

Imagine a Teller Station scanner of the *general design type* available from BUIC/CIT, Inc., Digital Check, MagTek, Panini, SEAC Banche, etc. This imaginary, small, comparatively inexpensive scanner has an auto-feeder that will hold 20 or more items and stacks items into a single output pocket. A generally U-shaped path or "item-track" having a length of 12" to 20" or so connects the feeder to the stacker. Along this path are arranged a MICR read-head, an Ink-Jet Printer (for trace line and endorsements), a front and back-side contact image sensor, and, perhaps some form of "stamping" endorser.

At the moment, we are not much concerned with either exact path length or the *relative positioning* of these devices. Our only concern is the distance along the pathway from where the nose of an unfed check rests in the feeder to the location of the contact image sensor that images the check front. We call this factor camera distance. The reason for this concern is that camera distance corresponds to a non-recoverable, *minimal* "dead-time" or latency to the beginning of any useful processing of a first deposit item. The importance of this factor will be evident in a moment.



We thus imagine two scanner models, identical in all salient regards except camera distance. For one the camera is assumed to be 2" from the feeder. In the other it is assumed to be 8" (6" further) down the track. Only because a value is required for calculations (and because that value falls into the range exemplified by the general design type), track speed for both is assumed to be 50 centimeters per second (about 20 inches per second). At the slower track speeds of some scanners of this general design type, camera distance becomes an even more important performance factor.

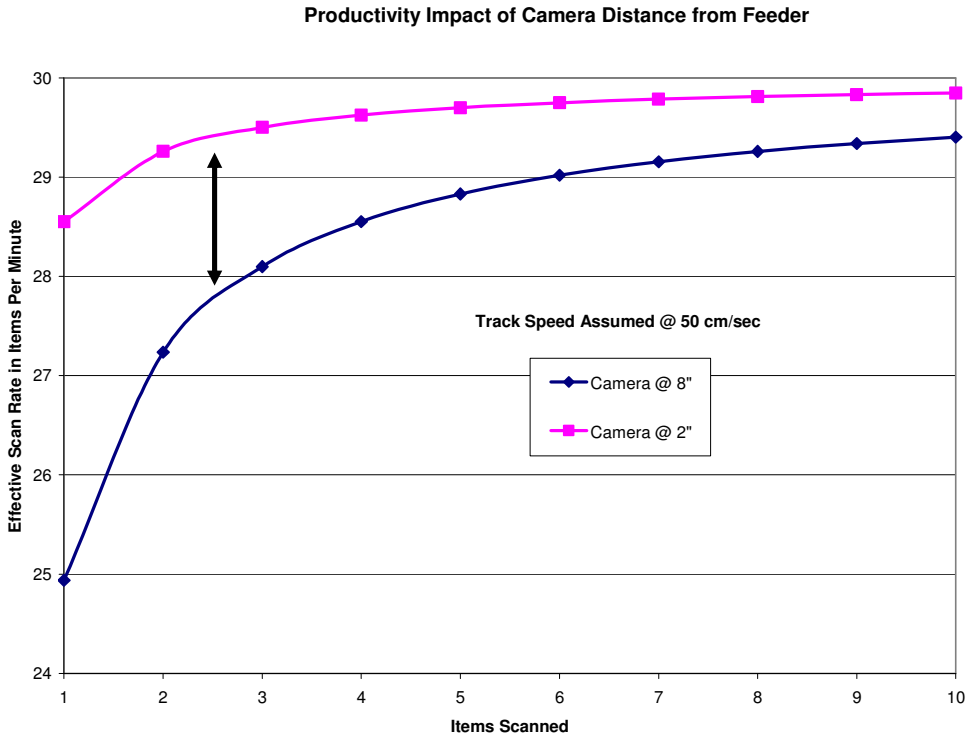
We will also assume that the performance of our two imaginary scanners is identical at 30 items/checks per minute ***when tested and reported in the "usual way."*** There are in fact two "usual ways." The first is calculations based on stop-watching the time required to scan the

[1] Of course, if the oversight becomes obvious only when pointed out by a competitor, this will lead to the oversight being creatively redefined as a product feature by marketing. I look forward to this brief paper leading to an outbreak of marketing creativity.

checks in a fully loaded hopper. The second is via software that extrapolates rate or a rate estimate from item-to-item timing measurements.

The problem with the "usual way" that Teller Scanner performance is rated is that it does not correspond to how Teller Scanners are used. Most deposits consist of a deposit slip (credit) and one or two checks (debits).

The figure below predicts relative performance for our two imaginary scanners under conditions more closely corresponding to real use. The metric is *Effective Scan Rate in Items per Minute*[2] relative to the 30 item minute norm measured in the *usual way*. Results are shown for a "scan batch" size varying from 1 to 10 items. The double-ended vertical arrow is intended to mark the domain of a most common 1 to 2 check deposit. The only factor causing the obvious difference in the two performance functions is camera distance with performance being superior when the camera is closer to the feeder.



An attentive reader, suspecting that the graph has been constructed to exaggerate a small effect (approximately 15%, maximum), may rightfully ask:

> *Since a deposit invariably consists of at least a deposit slip and a single check, why have you shown us a data point for just 1 Item scanned?*

To which we reply,

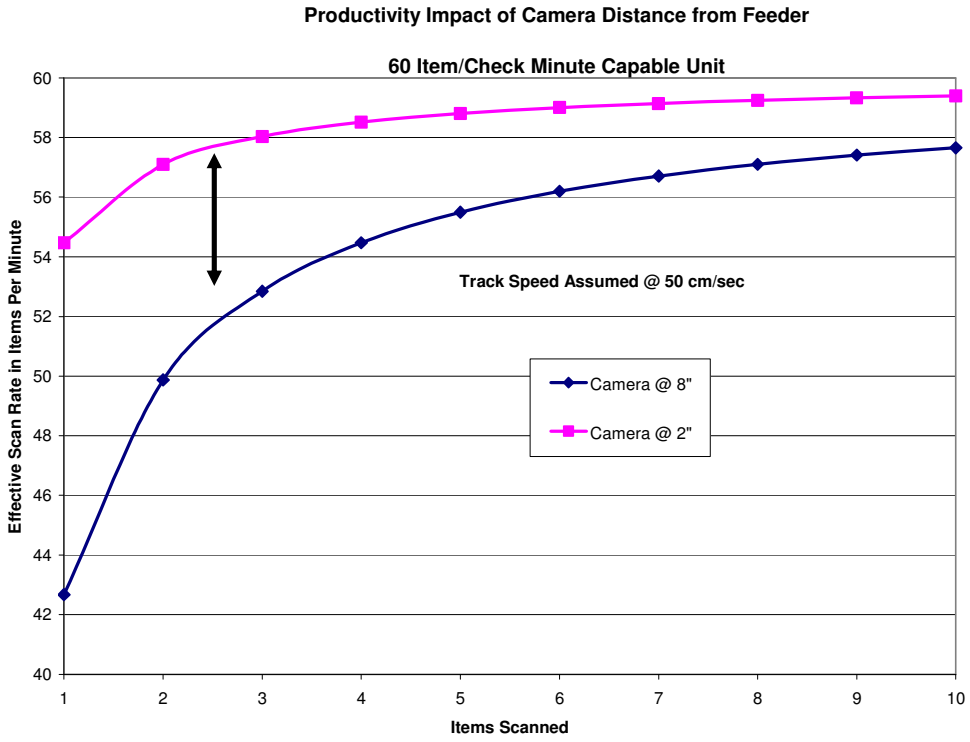
> *Good thinking, Grasshopper. And one as observant and intelligent as you would surely have foreseen the many operational advantages of constructing his Teller Scan*

[2] Our metric is not to be confused with some sort of productivity down-rating related to a wall-clock view of productivity. It is a calculation of instantaneous throughput taking into account that any difference in the latency to information for a first item is irretrievably lost.

application in a manner that made the feeding of a next item contingent upon processing and maybe even Teller input related to the prior item. And in such a case, an apparent deposit batch is really scanned as single items, causing you to pay the "first-item penalty" of a scanner design oversight for every item.

We are indeed saying that one "30 Check Per Minute Scanner" can in fact be a lot faster than another "30 Check Per Minute Scanner," when used at the Teller Window. We are also saying that the "slower" of two products may in fact be the faster in actual use. The linguistic problem is partly one of backroom productivity metrics being applied to a distributed Teller environment and partly attributable to the absence of a scanner performance metric that is clearly meaningful to a Teller-level device. We do not believe we are offering what will prove the final answer. But we do believe that performance curves as shown are far more instructive than scan rate.

Assuming a not unreasonable increase in unit cost, one approach to the issue we have highlighted is to buy a faster scanner. The chart below shows the same calculations for imaginary 60 check/item per minute scanners. The reader who looks critically at the scale will realize that the maximum advantage of the shorter camera distance design is very nearly 30%. So this design issue is of great importance in actually gaining effective use of the extra speed you purchased. It is not so much "how fast you go" as "how you go fast".

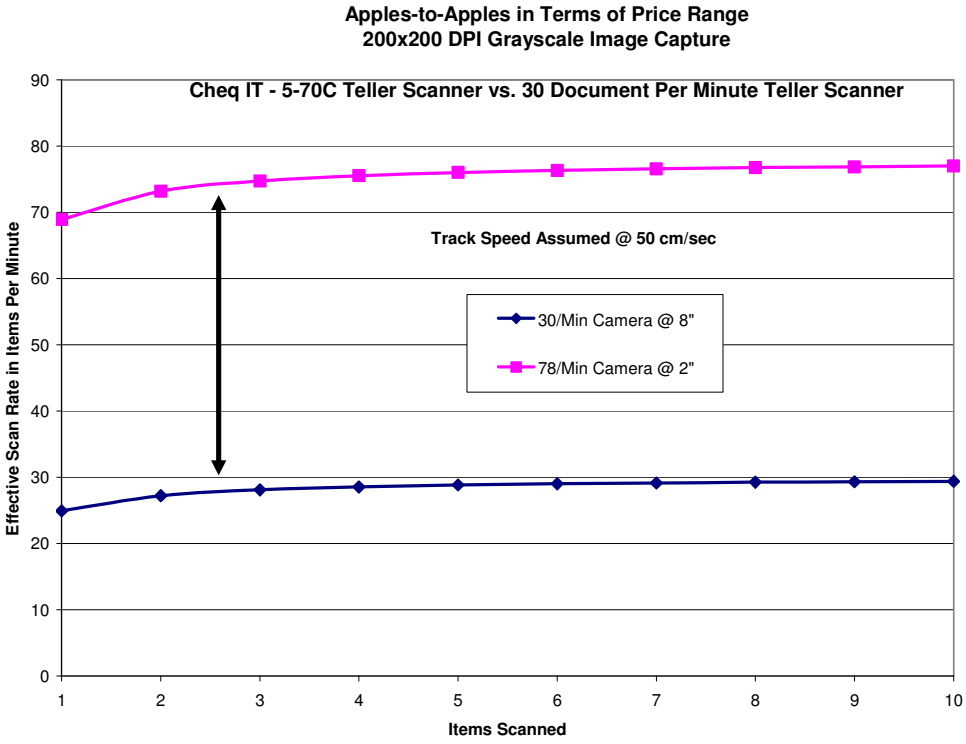


As you might have guessed, Teller Scanner products from BUIC/CIT, Inc., have had their design consciously shaped by this insight. As to scanners from other sources, we suggest you take a tape measure when you look at them. We also suggest that *Checks/Items per Minute* is not a reliable indicator of relative performance in a Teller scanning situation.

We are not saying this because our Teller-level products are comparatively slow. In fact, at a demonstrable batch scan rate of 78 personal checks per minute, for 200 dpi X 200 dpi, 8-bit

grayscale images, our base product (Cheq IT 5-70C[3]) is both the fastest *front-counter, Teller Window,* scanner on the market and price competitive with scanners that have difficulty benchmarking at 1/3 this speed.

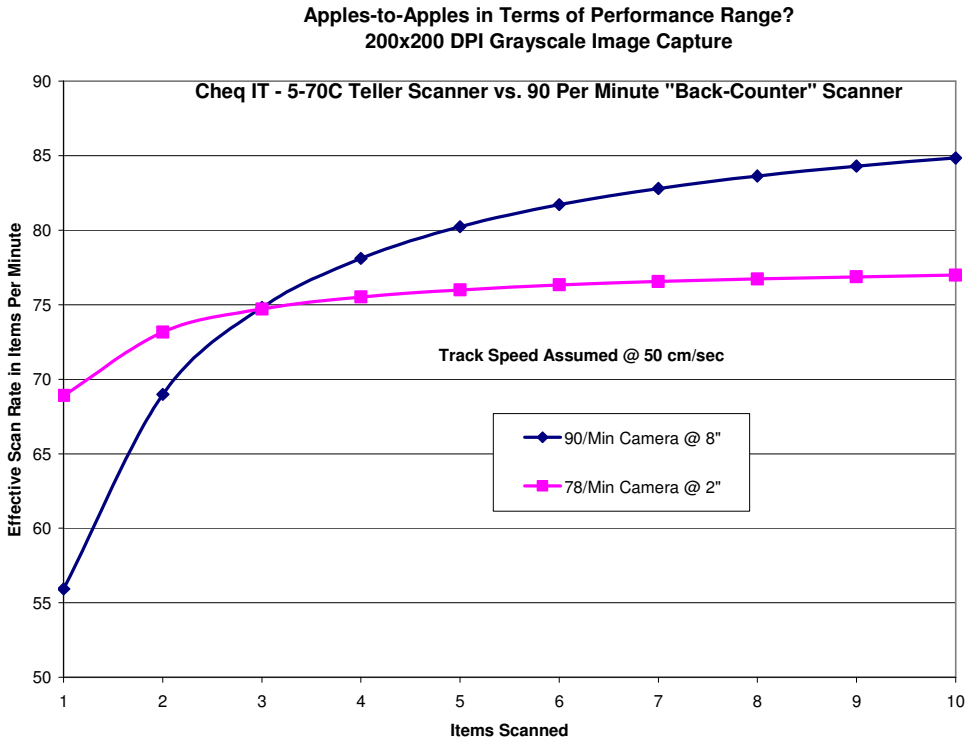
The next chart drives home the Cheq IT 5-70C's performance advantage relative to that typical of the "30 Items/Checks per minute" class of competing scanners recommended for Teller Station use. The "purple" function is for the Cheq IT 5-70C. As should be obvious, there is simply no comparison.



The final chart shows the performance of this product compared against a performance model for a 90 document scanner that would ordinarily be recommended for back counter use[4]. As this chart should make clear, when the image camera is located at significant distance from the feeder, batch size has to be fairly significant before the time penalty paid by a first document is amortized. Similarly, it should be noted that minimizing camera distance allows a "slower" scanner to be performance competitive within the realm of most common deposit sizes.

[3] This product includes color capture capability at no additional charge at a batch rated throughput of approximately 30 items/checks per minute.

[4] This chart speaks to performance predictions for a non-imaginary product and thus special note should be made that *calculations from a model is presented, not real data derived from testing*. A 90 item/check speed scanner was chosen for comparison because a product offering exists at this quoted speed range that is at least physically similar to similar to slower Teller Scanner products. However, the associated model values should not be assumed to typify performance of any specific existing unit because this model's *track speed* parameter may be an inaccurate characterization. Track speed in the Cheq IT 5-70C is also a dynamic controlled rather than fixed variable and while such dynamic variation does not notably cause model predictions to differ from observable reality, the model is still an approximation of even our own product's performance.



Conclusions

We have addressed this first design topic in isolation from related issues to clearly drive home both that performance matters and that a clear understanding of both ***how and why*** is lacking at the Teller Station. We have done so by trying to make very clear how a simple design difference that is without impact when evaluated by traditional metrics leads to meaningful performance differentiation in the context of Teller mediated scanning activities.

Generally, to date, scanner performance evaluation has been based on metrics proven in the back room. But, guess what. Not surprisingly, whatever they are, rules for good performance at the Teller level are different than for high speed scanning in an operations center. Because early adopters are not particular pleased with the performance they are getting, a better understanding will mature. Unfortunately, the Cheq-IT 5-70C was not available soon enough for these early adopters to have had the option of making a better buying decision.

What Haven't You Told Us?

Turning our attention to the several readers that have likely been irritated since somewhere near the bottom of the first page, like almost all engineering issues, a set of design trade-offs and other *apparent* requirements are associated with camera distance. And in this context, it is worth briefly asking why so many products reflect a design we are calling an oversight. We can identify three not especially flattering reasons.

1. While scanners of the *general size and design type* have been around for roughly 15 years, their use for image capture at the Teller Window is very new. As used before, camera distance is really not a significant performance factor because earlier application

lacked the real-time urgency of a transaction. Since most scanning experience and expertise came from a backroom operations environment accustomed to the demands of fast, but not real-time, it is easy to see why the issue escaped careful scrutiny. Replicating the past is always easier. CIT, Inc. and BUIC always consider a new design as opportunity to update and totally rethink our understanding of requirements and how they might best be addressed. But this is not necessarily habit in other organizations.

2. A less than perfect auto-feeder design tends to skew items and a bit of mechanical distance before the camera and MICR read head can be employed to "level out" what the feeder screwed up. We have always preferred to correct problems at their source. A cleaner, simpler, more reliable, less expensive design is almost always the result.

3. For microfilm check images in the soon to be old days, it is an absolute requirement that the trace line be printed on the check in advance of filming. Those who never knew or thought about why this was true for microfilm seemed to blindly replicate this as a requirement for small check scanners. Consequently, we see specifications that emphasize that the trace line Ink Jet Printer is located in advance of the camera *so that the trace line will appear in the image*. This was true for microfilm. So the legacy practice must be perpetuated in digital image. In any event, the design consequences are that the printer must be located in front of the camera and because smearing wet ink onto the contact image sensor is not good, the camera has to be a ways further down-track from the printer. This is an affirmative, though bogus, design rationale.

   There are three problems with it. The first is that camera is not far enough away from the printer to reliably avoid having its surface dirtied by ink. The second is other than adherence to legacy ritual, there is no need to print before image. And the third is that there is a much better design solution that yields far more reliable outcome.

   What those that follow this path did not know or did not understand or did not question is *why print before image is a requirement with microfilm*. The simple fact is that microfilm indexing for check image retrieval is only approximate. Without the sequential elements of a Trace Line appearing in the image, retrieval is painfully slow and prohibitively expensive. This issue simply does not exist with a digital check image. Image retrieval is by means of an exactly correct, absolutely item-locked, digital index.

   There is a need for the Trace Line to appear in the check image and there is a need to print the Trace Line on the check. But the Trace Line can be "digitally stenciled" directly into the check image with greater ease, clarity, and reliability than if it is printed before the camera. And an equivalent Trace Line can as easily be printed on the physical item after the camera, totally eliminating the problem of ink residue clouding the camera and reducing user maintenance requirements.

So the bottom line is that while some readers may become irritable, we have no comfort to offer them if their scanner is one of those with substantial distance between the feeder and the camera. This simply is a less than optimal design.

In closing, we note that our President asked if we really wanted to come right out and tell our competition how to build a better scanner. In response, we said that if we wanted the market to buy our product, we owed them a clear understanding of why that was a good decision. We added, besides, the market has an established history of copying BUIC's good ideas. Anybody who does not want to buy from us will probably have to wait eighteen months to buy it from somebody else no matter what we do or say.