The indisputable "no-spin" guide for Wide Format Scanner Buyers

EXECUTIVE SUMMARY

With only a few players in the world-wide market, the task of selecting your next wide format scanner, *based on your needs*, is manageable. Be critical when looking at the manufacturer's specifications. Sometimes the manufacturer specifies features that are not necessarily benefits that can translate into an improved bottom line for you. *We can provide an outline for your use to determine you needs.*

First - determine you physical scanning needs and be careful not to go wider than what you need. The best bargain priced scanner supports a maximum scan width between 36" and 42". If you choose a wider scanner, you may pay a relatively high premium for the extra scan width.

Second - choose the scanning resolution that will meet your quality demands. Ignore the specification for *maximum scanning resolution* which is done by simple scaling. Use the *optical scanning resolution* as an indicator of quality and select a scanner with a higher optical resolution, assuming all other measures are equal. Comparing between brands should be exercised with caution since quality varies even with nearly identical specifications.

Third - be careful when evaluating color scanning performance. The *connecting PC is the bottleneck* and therefore it is often questionable to select a scanner that provides a color scanning speed above 1-1½"/sec at 200 dpi. In other words, it is more beneficial to ensure you are using a high performance PC than a high performance scanner.

Fourth - always estimate how many documents you will need to scan over a selected period of time. (Without that number, a return on investment analysis cannot be performed.)

Fifth – Do your own shopping around or let us help you find your next scanner at the right price and with the right specifications, meeting your requirements.

Scope of the buyers guide

There are only a few manufacturer's serving the world-wide wide format scanner market. This is both good and bad. The good part is that you only have to investigate a small number of manufacturers' in order to select the scanner that meets your needs. The bad part is that your choices are limited.

When you dig into the matter, you will soon discover that scanner manufacturers' are mostly selling "technology". This is not necessarily bad, however you would need to filter the information and evaluate it based on something that can translate into real business benefits for you.

This guide is not intended to be an in-depth or comprehensive guide to the wide format scanner industry. Instead, it is intended to provide you with a clear understanding of how to shape you needs and to narrow down your choices for your wide format scanner.

When we talk about a "wide format scanner", we are specifically referring to the stand-alone wide format scanners, and not the multi-function devices where a scanner is build into a printer system from manufacturers' like HP, Canon, Oce, Ricoh, Xerox, KIP, etc. These multi-function scanner/printer systems are another interesting topic that will be covered in detail at a later date.

This Buyers Guide first takes you through who the players in the market are and their respective market share. Then we address the first buyers question "What really matters when considering the purchase of a wide format scanner?". We then continue to the more practical aspect of determining your specific scanning needs, and how to narrow your choices down to a manageable list of 2-3 different scanners. Finally, we conclude the discussion with "where to go from here".

Who are the players?

There are four major manufacturer's in the world.

www.contex.com

www.colortrac.com

www.graphtecusa.com

www.imageaccess.de

Of these four, Contex offers the same scanner under four different brands, namely;

www.contex.com

www.vidar.com

www.widescrns.com

www.oce.com

The differences between the various Contex branded products are cosmetic. E.g. a different streamer or color touch-pad. The functional specifications and actual performance *is identical*. Although the products are identical, the differentiation relates to their level of commitment to quality customer service and technical support.

What is their real market share?

Although all 4 manufacturer's claim to be the "*leading supplier*" of wide format scanners in the world, any market share percentage claims should be considered with caution. Don't read too much into their market share, what is important is that you find a scanner that meets your business needs.

What really matters?

Based on a survey from Digital output in 2003 the top 5 most influential buying criteria when considering a wide format scanner was:

- **Price: 30%**
- **Reliability: 12%**
- **Quality: 11%**
- **Performance: 11%**
- **Customer service/Tech support: 10%**

You should pay attention to the fact that neither "**brand name**" or "**features**" reached the top 5 list! What does this tell us?

It tells us that you as a buyer are looking for the best bargain (price) high reliability (works day and night) and quality (represent the actual drawing accurately) and scanning speed (performance); and in case something happens, you have a support and service provider backing you up to minimize down time.

Why did brand name and features not make the list?
The answer to this question is simple - none of the manufacturers' have been able to differentiate their product offering in the market place such that it represents something unique and appealing to the buyers. In addressing the buyers needs, all of the scanner products will be able to meet most scanner needs of today. Features are just another *buzz word* that does not really appeal to buyers today. In the beginning of the large format scanner era (1988-1996), most buyers saw the features list as a way to gain competitive advantages, but as the scanners move from the early adaptors into the early commodity (1996-2004) and main stream (2004-present) the importance of features dropped significantly, as clearly expressed in Digital Output survey from 2003.

Price
This is the single most important factor that determines your return on investment and the tangible benefit that it can deliver to your business. Scanner prices have been fairly constant for the last 15 years. When manufacturer's have released new products, they have maintained the price level equal to the product it replaced, although they have added more features. This worked well in the early

stage of wide format scanners, but as the need for features has diminished or is less significant to the buyers, the buyers focus has been on getting the right price for the features needed and not paying for features they didn't need. It's my belief that in today's market, the officially stated MSRP price is "*excessive*" and there is growing downward price pressure that will force the market to a correction in the foreseeably near future.

Reliability

This is the happy story. A scanner has very few moving parts and all of the scanner manufacturer's can produce highly reliable scanners that last a long time. Most scanners support downloads of new firmware and software making it easy for buyers to correct bugs. After a scanner is up and running, its reliability is usually higher compared to other peripherals like printers, and most of the maintenance can easily be performed by the buyers without involving a technician to perform the task.

Nowadays the wide format scanners sold in the U.S. are backed by a 2 year on-site warranty, further eliminating the issue with reliability. A little warning note is needed however. When a manufacturer ships new products, expect frequent firmware/software updates for about the next ½ year. This is the typical amount of time it takes the manufacturer to resolve most bugs in the system. It also indicates that you should not eliminate a new scanner model just because you have seen a bad demo or seen that the quality is not up to the standard. For a newly introduced scanner this is to be expected, but rest assured that ½ year down the road, the scanner will work as expected.

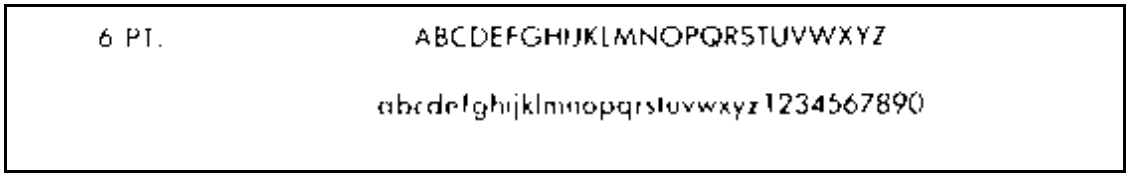
Quality

Everybody wants quality today and most often they get it! From a manufacturer point of view, all scanners are quality built and should show similarly low failure rate. There are two scanning issues to consider however; black & white scanning and color scanning. Then there is a general rule of thumb that the higher the optical resolution a scanner has the higher the potential to deliver increased quality scans.

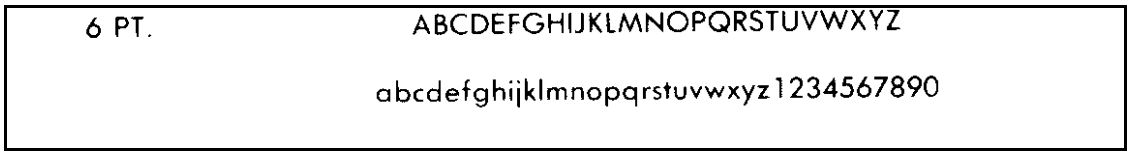
Black & White quality

Today, black & white scanning rarely presents an issue. From a scanner perspective, all scanners can handle B&W fairly well. What determines the scanning quality is the "line pair/mm". The higher that number, the more alternation of black & white pixels can be detected, resulting in a more accurate scan. This concept is not easy to grasp, so I will use another analogy with contour lines in a map. The contour line in a map represent the elevations, if we have steep descent or climb, the contour lines are positioned very close together. A scanner with a low "line pair/mm" rating, the contour lines bleed together while

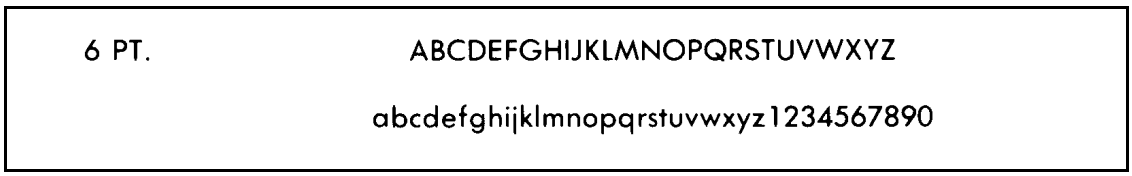
on scanners with a high “line pair/mm” rating, the contours are kept separate and therefore the resulting image more accurately represents the scanned map. No scanner manufacturer specifies line pairs/mm, so optical resolution can be used as a substitute for that measure. The question from a buyer perspective is “what is high enough resolution?”. The application for Black & White scanning is quite often engineering drawings. Most engineering drawings can be scanned sufficiently with resolutions between 200 dpi and 400 dpi and since all scanners on the market is capable of doing that, your choice is not very limited. Below are 3 examples of 6pt text font scanned on scanners with 200 dpi, 400dpi, and 600 dpi optical resolutions.



A 200 optical resolution scan of a 6pt text font



A 400 dpi optical resolution scan of a 6pt text font



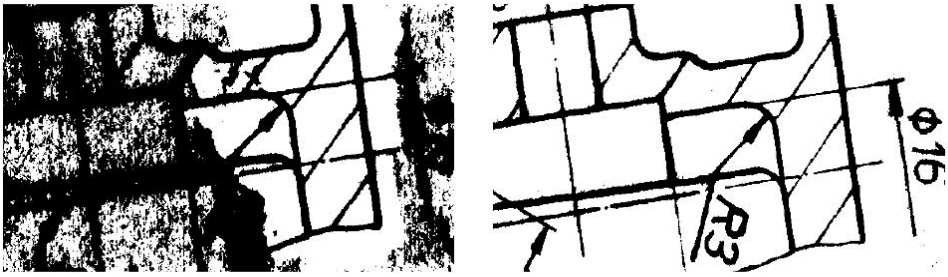
A 600 dpi optical resolution scan of a 6pt text font

As can be seen, the 200 dpi optical resolution is at the critical end of acceptable quality for small text. The 400 dpi is considerable better, although it still shows some jagged characters. The 600 dpi sample is clearly the best with smooth and nice edges. The sample of different resolutions leads us to the following recommendation: *Always favor scanners with higher optical resolution, keeping all other measures equal*.

Black & White drawing quality

Here we are moving into the forgotten art of cleaning up detiorated drawings and blueprints. In the early nineties, this was a big topic because of the introduction of “adaptive thresholding” that suppressed background noise in the drawings and delivered a better quality scanned image than the original. Today however, all scanner manufacturers offer some kind of adaptive thresholding to “clean-up” the original. If you are interested in scanning older engineering drawings you should

pay attention to the various thresholding features. However, adaptive thresholding is not a 100% accurate technology and from a buyer perspective, the difference among the manufacturers as a result of using this technology is marginal.



Before and after adaptive scanning. The "nice" result on the right side is rarely seen in real life, however you do get significant improvement when compared to your original.

Color Quality

This is where most new buyers are looking toward. When scanning in color, it is usually understood to be 24 bit color. A special application exists for indexed color (maximum of 256 different colors), but with the increase in storage capacity and compression technique (JPEG and JPEG 2000) the need for 8 bit color is quickly fading away. 24 bit color is what you are getting out of the scanner, however the internal number of bits the various scanners can capture ranges between 36 bit to 48 bit as their internal color capture. The manufacturer's make a big sales pitch about the number of color bits they capture per color channel and claim the more bits, the better color quality. Theoretically there are right. However if the scanner only outputs 24 bit color, how much internal color capture is enough?

First of all, the problem is more visible in the darker end of the color spectrum. The reason is a human eye does not see color linearly like the color capturing technology does, so color data is passed through a gamma filter. Unfortunately the side effect of that is that it creates "holes" in the darker end of the color spectrum which means that darker color is not represented as correctly and visible color posterization can be seen. To answer the question of how many bits is enough, lets looks at the following pictures showing the result of capturing various shades of gray with 24 bit, 30 bit, 36 bit, 42 bit and 48 bit color capture. I personally can see the differences at the 24, 30 and 36 bit but my eyes can't see the difference between 36 and 42 or 48 bit! From my point of view, 36 internal color capture should be enough for most buyers.

Below is example of the difference between 24-bit to 48-bit color capturing. As you can see, the difference between 24-bit and 30-bit is obvious. Less obvious from 30 bit to 36 bit and above 36 bit it's really hard to tell.

24 bit capture

30 bit capture

36 bit capture

42 bit capture

48 bit capture

Performance

This is my favorite topic. Price/Performance is always a good topic to be discussed and over the last few years we have seen scanner manufactures claim higher scanning speed which top-out around 8-12"/sec at 200 dpi B&W and around 3"/sec at 200 dpi 24 bit color. That's sound great, but wait, let's not get too excited.

A couple of years ago I talked with a friend of mine that owns and operates a scanner service shop. He told me that the actual scanning time only represents about 20% of the total service time required to handle and scan a drawing into a file or document management system. With that in mind, a doubling of the scanning speed only yields a 20% improvement in throughput. But that is not all. All speed specifications you read are based on the theoretical output from the scanner. What happens in real life is a different story and therefore as a piece of buying advice *don't put to much into the marketing speed specs from the manufacturer*.

Different buyers will have a different need or different urgency level for scanning. E.g. a service bureau wants to turn around copy jobs as fast as possible and therefore performance is more important than a project based in-house job of scanning 10,000 originals over the next year.

Black & white performance

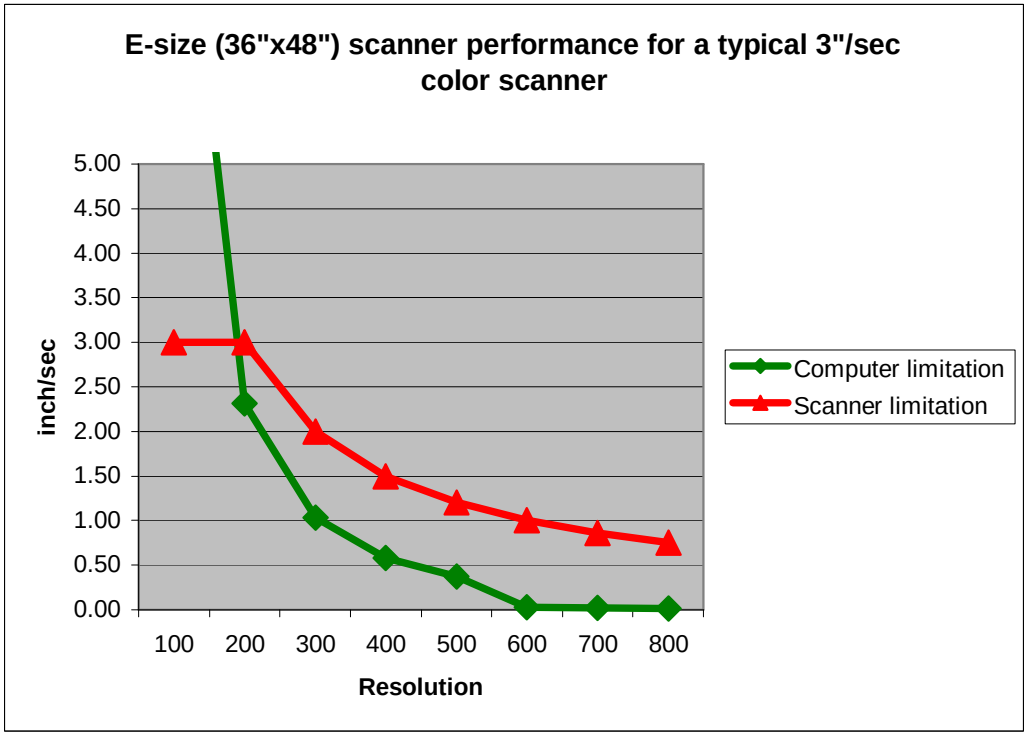
The nice part about Black & White scanning is the small amount of data that needs to be sent from the scanner to the PC; typically in the range of 1MB to 10MB of black & white data depending on the complexity of the drawing. Now let's look at a typical high performance Black & White scanner that has a speed rating of 10"/sec. An E-size original of 36"x48" should take only 4.8"sec to scan. However, in real life, you will observe that the scanner does not react at once and a typical delay of 1-4 sec is observable from the time you hit the scan button until the scanner is actually scanning. Our 4.8 sec scan time then increases to 6-9 sec for an E-size drawing. This scan speed is equivalent with an average speed of 5.3"-8.3"/sec or an underperformance of 17-47%. For a D-size (24"x36") drawing, the difference is greater and the observed average scan speed is 4.7"-7.8" or an under-performance of 22%-53%. In reality however, we are only talking about seconds and for most applications this is not really the issue.

Color scanning performance

For color scanning performance there is really a discrepancy between marketing specifications and observed performance. Take for example an E-size 400 dpi 24 bit color scan. The amount of data that needs to be sent to the PC is around 830MB. A typical high performance color scanner states the speed to be 1.5"/sec or 32 sec for a 400 dpi color scan. This translates into a data transfer rate of approx 26MB/sec. Can the scanner deliver this amount of information per second? This answer is yes. However what about the Firewire or USB cable throughput. The answer is maybe. 25MB/sec sustained is really at the top of what you can expect to get out of a Firewire and 20MB/secfor USB cable transmission. Can the PC handle the amount of data? This answer is a loud **NO**. For a standard PC, expect a transfer rate of around 5MB/sec and high end PC a transfer rate of 10MB/sec. From a practical point of view your PC is the real bottleneck that will prevent you for utilizing your scanners color scan speed. Recently some scanner manufactures are begining to offer enhanced USB2 performance (**Contex,Vidar,GTCO Calcomp & Océ**)that raise the performance to around 32MB/sec better coping with the amount of color data. Others are following the route of Gigabit internet (**Image Access & Colortrac**) that also can sustain data transmission above 30MB/sec.

To further illustrate the point, the chart below shows the theoretical scanner performance (red curve) of a color scanner rated at 3"/inches per second scanning an E-size drawing (36"x48"). With higher resolutions the speed in

inches/second goes down to around 0.75”/sec at 800dpi. However when we add a high-end PC with a limitation in performance of around 10M/sec (green curve) we can see that above 200 dpi the limitation is affected by the connected PC that severely limits the scanner throughput. This observation leads to the conclusion *that the buyer should not pursue color scanning speeds above 1.5”/sec at 200 dpi. Instead the buyer should more wisely spend their money on a high-end PC. Scanners with enhanced USB2 or Gigabit interface push this recommendation to 2.5”/sec*



Determining your needs

First decide on the length of the investment period. Typical accounting practices depreciate a capital investment over 5 years. Furthermore, scanning quality is mostly dependant on the optical resolution of the scanner. From a technological point of view there is no limitation with today’s technology to build a 800-1200 dpi optical resolution scanner (today’s scanners top-out at 600 dpi) so it is reasonable to expect with time that the main stream optical resolution will increase today’s average from 400 dpi to 600 dpi and even higher over the next 1-5 years. 5 years seems to be a reasonable length of the investment period.

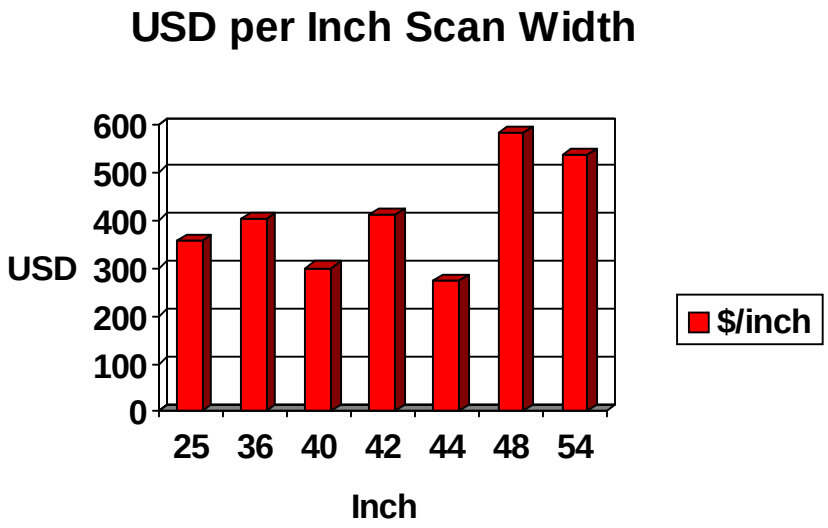
Physical limitation

Next determine your minimum requirements of scan width and thickness of material to scan. For engineering companies that want to convert their legacy paper drawings, achieving this is easy. They just have to determine the maximum width of their drawings. The length does not matter since all wide format scanner manufacturers support unlimited scanning length. For a “print for pay” shop, it is more difficult. If they restrict the scan width they potentially have to turn customers away if their drawings exceed the scanner width. On the other hand, scanners that can scan wider images are usually considerably more expensive than main stream scanners and usually limited in numbers. There will therefore be a trade-off of scan-width and scanner price, which should carefully be evaluated when deciding to invest in a wider scanner or not. E.g if changing your need from a 36” to a 42” scanner expect that the average price will increase about $2,800, as indicated in the table below.

Scanner width	Average MSRP price	Price range (MSRP)	Number of scanners
25”	8,919	6,915-10,790	7
36”	14,473	9,995-17,790	10
40”	11,965	11,415-12,515	2
42”	17,283	13,115-22,490	22
44”	12,017	10,550-14,050	9
48”	27,990	27,990-27,990	1
54”	28,918	27,900-29,490	4

Based on October 2008 MSRP pricing and available manufacturer models

The price/scan width ratio revealed that the best price/scan width ratio is around 25-42” scan width. Expect when needing a wider scanner that the choices will be limited and your will pay a premium price for wider scan width.
The price/scan width ratio reveals that the best price/scan width ratio is around 25-40-44” scan width.



To finalize the discussion on the physical needs, you will need to decide whether your next scanner needs to be able to scan thick media. Thick media is usually originals mounted on a foam board, gator board or other material. ¼" thickness is the most common for mounted originals. The good part is that all scanner manufacturers support thick media scanning although not true on all of their models. The "thick" scanner models can usually scan thick media in the range from 0.47" to 0.75"

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Determine your resolution needs

This is the second most important decision you will need to make. All of the scanner manufacturer's scanner models can scan between the ranges of 50-9600 dpi. This seems to be more than enough. However the highest optical resolution these scanner can deliver is between 200-600dpi. All other resolutions are obtained through interpolation which only adds more redundant data to your image file but does not produce any real data from the image. A couple of years ago there was a marketing war between the scanner manufacturers based on who could produce the highest scanning resolutions. Great for marketing, no value for the buyer.

How can I determine my scanner resolution needs? Well over the years some guidelines have been established by industry experts and it looks like the consensus is around the following:

Work to do	Optical resolution needed
Scan-to-Archive	200-300 dpi
Scan for Raster editing	200-400 dpi
Scan for Raster to Vector conversation	200-500 dpi
Scan to print	200-400 dpi
Scan to GIS	400-600 dpi

Typical Resolutions for different scanning applications

Scanner Resolution	Number of scanners
400 dpi or above	85
500 dpi or above	79
600 dpi or above	76
700 dpi or above	9

Based on October 2008 available manufacturer models.

As can been seen, all manufacturers support 400 dpi or more. If you scan to archive you should consider 200-300 dpi optical resolution, otherwise stay with the mainstream around 400 and go higher if scanning to a GIS application.

Determine what is NOT part of your criteria.

Let's face it - a scanner today is not the solution in itself, it is only part of the solution. Today it is how and for what purpose you use the scanner that is important. In other words what application are you using to solve your business needs? As the scanner manufacturer's see that the focus is not on the scanner itself but on the application, they seek to add differentiation to the scanner hardware and try to pitch technology differences between the two different scanning technologies; CCD camera based and Contact image sensor (CIS) based. The CCD area is further divided into folder optics and straight through optics. Granted there is a special case where you can demonstrate that one technology works better in some area and vice versa but for the mainstream needs - you couldn't care less. The purpose of this buyers guide is not to go into a religious discussion about the advantages/disadvantages of the various scanning technology, we will reserve that for a future report.

Why should it matter that they're talking about the different scanning technology? The reason is quite simple - there are a number of different scanners out there with similar specifications and therefore it is natural that you begin to pitch the underlying technology. However knowing the differences between *benefits* that add value to your bottom line and scanning *features* that do not add value to your bottom line is the most important issue.

Should scanner performance be part of my criteria?
Yes and no - it depends. But don't put too much emphasis on it, particularly if you are dealing with color scanning at 400 dpi or higher. Let's look at an example from before and reverse calculate our real color scanning speed. If our PC is a high end computer with the capacity to handle 10MB/sec scanner data transfer, then an E-size (36"x48") can be processed by the PC in 83 sec. This is equivalent to accepting scanner data at a rate of 0.6"/sec. In other words, we would only see a throughput of 0.6"/sec from a scanner rated at 1.5"/sec. In this example the benefit of a high end color scanner is zero when viewed from a performance perspective. For black & white scans the benefit is more tangible because neither the PC nor the Interface (Firewire or USB) will slow the scanner down. This observation leads to the following conclusion: *It is more beneficial to spend the $ on a high performance PC than spending it on a high performance scanner!*

Another factor to be considered is in regards to scanner performance for use in "scan to print" applications. Today's printer technology is considerably slower than scanning technology and therefore if the majority of your need is for scan to print, then you should have less focus on scanner performance and instead spend the money on higher printer performance.

Determine number of drawings to scan over a period.
This is a must. If you don't have a number you should estimate one, otherwise think twice before you invest into scanning technology. What it all boils down to is whether your investment has a positive return over the period of use (5 years). When considering a scanner it is a requirement to perform some kind of Return on Investment (ROI) analysis, either by calculating a NPV (Net Present Value) of your investment or IRR (Internal rate of return), or whatever payback criteria your company is using to justify your investment. This leads to the following recommendation: *If you can't justify your purchase based on a ROI analysis then don't purchase anything! The o*nly exception is the convenience aspect of having a scanner in-house versus out-sourcing.

Narrow your choices down?

So far, we have mostly focused our discussion around what should be part of your buying criteria and what should not. To get to the final touch, aimed with a much better understanding of your need and requirements you can now shop around to find dealers that can fulfill your requirements at the lowest possible price.

If you need professional services to handle your procurement, we can help you. We know the market, we know where to get the best deals, saving you countless hours and money for your next scanner purchase.

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About the Author
Henrik Vestermark is an independent consultant and professional who has worked in the wide-format scanner and printer industry since 1988. His expertise includes all aspects of the wide-format digital capture market, and particularly focuses on the wide-format scanner industry.