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Paperless construction, in a nut shell, is the use of online or electronic programs for managing contracts, changes, drawings, submittals, RFIs, correspondence, lab data, and inspection reports (Construction). The paperless construction movement is making its way through all types of construction, including residential, commercial, and heavy highway. It affects the whole project, from pre-bid, to project management, to closeout, and as the industry constantly becomes more paperless, contractors are forced to make changes in their processes to keep up with the trend. Peters Construction Corporation in Waterloo, Iowa, is an example a company committed to keeping on the leading edge. Peters already uses some advanced software and hardware in the office to effectively handle their business, but they realize constant change is a must to remain competitive.

Currently, PCC uses Timberline Estimating, Accounting, and Project Management software. The estimating software electronically automates the estimating process to maximize accuracy and efficiency, thus saving the estimating department much time and effort. The accounting software works with the estimating and project management software to quickly and accurately manage the books. The program makes it easy to show a breakdown of job costs, as each process is coded into the accounting records accurately. Timberline Project Management stores all the project documentation, including RFIs, change orders, submittals, and transmittals in one central database, allowing the easy generation of reports and inquiries. The estimating department also uses a Digitizer, which quickly and accurately generate linear, area, and counted takeoff, reducing manual spreadsheet and paper calculations (Timberline). Even though the staff at PCC has access to this valuable software, none of the programs are used to their full potential, and constant updates of hardware and software are a must.

The main question this paper focuses on is "What steps do contractors need to take to transition into and maintain a competitive edge through the paperless construction movement?" The answer may not be the same for every organization, but our goal is to present Peters Construction Corporation three options they can implement into their operation to effectively move toward paperless construction. The three options are a wide-format printer/copier/scanner combination machine, iSqFt, and Electronic Construction Closeout.

Importance of Comparisons

When dealing with issues of whether a company should invest resources into change it is important to first examine other construction companies, as well as others involved, such as: subcontractors, architects, and suppliers (Snyder). This will give a general idea of where the mainstream is, and where a firm would have to be to be on the leading edge. It is important to be on this leading edge; however a company does not want to get too far ahead, as is evidenced by interviews displayed later in this research. To understand where the general trend is in paperless construction, other construction companies will first be examined, (with subcontractors included) followed by architects, and finally a general look at the industry.

Contractor Comparisons

Since this study is designed to answer Peters Construction Corp.'s questions on paperless advancement, it was felt that it would not be ethical to inquire Peters' competitors as to their level of paperless technology. Therefore, two companies were interviewed that do not compete with Peters for projects: Peterson Contractors (PCI), and Civil Constructors.

Peterson Contractors Inc.

Founded in 1964, Peterson Contractors, Inc. is a heavy and highway contractor based in Reinbeck, Iowa. With projects completed throughout the continental U.S., PCI has expertise in grading, site work, demolition, crushing, structures, geo-piers, deep foundations, earth retention, and design build projects (Peterson).

PCI is actively converting to electronic software in many areas of its operations including: estimating, electronic closeout, receiving of plans, and drawing submission. Following is an interview with Doug Clark, who is the lead structural and Geo-pier engineer, to explain in depth what PCI is doing.

PCI began its paperless construction quest with estimating software, and the process is now used on every project. "We have used programs in Microsoft basic and excel for many years. Most of these are home built and we recently started using a purchased system Hard Dollar for estimating and logistics management" (Clark).

Since Iowa now makes their project plans available online, the next logical step was a transition to being able to receive those plans electronically. "We use iSqFt extensively and the Iowa Department of Transportation (IDOT) has all of their plans available online and the bidding is through email. However, even though most of the activity is on-line, we still get a paper copy of the plans and specs to review and mark up for estimating" (Clark).

Another process that requires enormous amounts of time and paperwork is the closeout of a job. PCI has been trying to find a way to change that. "We are trying to change our ways in the closeout process of our jobs. Lately, the IDOT has been almost all electronic, and many other companies are as well. It depends on the contract holder, but

almost all general contractors and owners are at least partially electronic in this manner. We try to at least keep up with the mainstream in this area, if not lead it" (Clark).

While the processes just mentioned are some of the areas where PCI has changed, they are currently in a transition mode with drawing submissions. "Instead of shipping paper fire logs all over, we can send it electronically faster and more efficiently. We used to lose two weeks mailing time with a standard paper drawing transmittal that now takes seconds. We actually request as much as possible to get Geo-pier bid requests and especially soil borings electronically since they are so much easier to read than getting them faxed several times. Our work is getting too complicated, too large, and time demands are too great to perform any other way" (Clark).

It is evident that PCI is changing its ways drastically to keep up with the technological times we are in. However, let's look at another company to see if the change is evident in multiple places.

Civil Constructors

Civil Constructors is a heavy civil, commercial and industrial contractor whose principal markets are public and private sector construction projects including commercial facilities, roads, bridges, underground utilities and industrial facilities. Their main offices are located in Illinois, where the majority of their work is performed. Art Snyder is currently serving as president.

According to Mr. Snyder, Civil is making significant strides in certain areas of paperless documentation; however, they are also careful not to get too far ahead of their subs and suppliers. "When deciding if change is in order, we have to remember that smaller companies do not have the resources to keep up with all technological change, so

we must decide if the technology we are investing in will be compatible with the other companies we work with" (Snyder). With that being said, management at Civil has been making some changes that they feel will give them a competitive edge.

One of Civil's first projects was to buy a scanner and copier for the office. "We felt that having our own would save gas expenses, be more convenient, and would allow for more work to be finished at an increased pace, and we have not been disappointed with that decision" (Snyder).

Another agenda on Civil's list was to convert to electronic bid software. This was accomplished by investing money and having professional consultants design a work package in Microsoft Excel that was tailored to their bidding process and style. "This has had tremendous benefits and we are very satisfied with the finished product" (Snyder).

Other processes have also been changed at Civil Constructors. For instance, many aspects of cost and job accounting are now documented electronically, with no paper record kept. Invoices are scanned into the system, although they are still documented in paper as well. Bid plans are received in an online bid plan room, available in both Iowa and Illinois.

Some aspects do not change however, such as job closeout. "In Illinois, a paper record is still required in the closeout process; hence we do not invest in electronic closeout software. This is one of those instances where we are careful not to get too far ahead of the mainstream, because it will end up costing us money for no appreciable gain" (Snyder).

Input from Architects

When examining technology to see if a change is necessary, it is vital to look outside the realm of contractors and into other elements of the construction process, such as the owners and the architects. Since contractors will be working with both, especially architects, it is important to understand what technologies they are using so that the process of cooperation can proceed as smoothly and efficiently as possible. To accomplish this task, two architectural design firms were contacted: representatives from RDG Planning and Design, and InVision.

RDG Planning and Design

RDG is an architectural firm based in Des Moines, Iowa that specializes in commercial work, community and regional planning, mechanical and electrical, and landscape. Mike Andresen is a design associate that has worked with various owners and contractors in commercial buildings and housing developments.

One of the things that surprised Mike is that construction companies are pushing for increased technology in their companies. Most of their problems come from the owners they work with, who do not keep up with the software. "It seems the normal stereotype is that construction firms will lag with change, and will only do so grudgingly. However, it is evident that bigger contractors realize the costs involved with their massive amounts of documentation, and are taking steps to try and minimize the costs" (Andresen).

Architects at RDG have been using the AutoCAD system for quite some time now, but they are currently switching to a new program called Revitt. Revitt is a complete program that allows RDG to design the project, make 50, 75, and 100 percent

drawings, and come up with a complete material quantity estimate all at once. "It greatly reduces our costs, due to less time spent on design, drawings, and having the estimate be completed at the same time the design is finished" (Andresen).

There are also other areas where RDG is changing its operating pattern. Currently, their main objective is converting the majority of their shop drawings to a computer directory, instead of a file cabinet. "We estimate that we have almost 90% of these drawings in the system now. We also try to put all of our plans in an online plan-room for our contractors to access. Because subcontractors and smaller general contractors have a hard time affording all of the necessary plans for every job, we feel that this is a good way to cut costs for all involved and help with relationships at the same time" (Andresen).

InVision

InVision is an architectural and planning firm based in Waterloo, Iowa. Their main focus of work consists of schools, hospitals, clinics, and churches. Ron Teisinger is one of the lead architects for the firm, having designed and overseen the creation of many projects for InVision.

From the phone interview conducted, it was apparent that Invision has many similarities to RDG. They are also transitioning to the Revitt program, put the majority of their drawings in electronic version, and put their plans online for contractors to view. They also have the same issues with smaller contractors and owners. "We find that the large contractors are really pushing the electronic age," said Teisinger. "However, the problems arise with the smaller contractors who do not want to spend the resources to

convert to electronic, which leads to discourse in the system because of having to do things differently for different contractors and owners" (Teisinger).

Wide-Format Scanner

When the topic of paperless construction was first introduced to PCC, specifically Vice President Brad Best, the issue of implementing a wide-format printer/copier/scanner into the office was of most interest. They presently face numerous situations in estimating and project management that require the use of this type of machine, but with the lack of resources they are forced to spend time and money outsourcing the work (Best).

The major issue that requires the need for this machine is electronic submittals. This specifically comes about when working with the University of Northern Iowa, which PCC does much of. Currently, the University requires the use of Centric Project, an online project management software, for electronic submittals, requests for information, and scheduling. This requires the project manager to upload all related documents into the system through scanning. Standard 8"x11" documents present little problem, as a small scanner can quickly scan and upload the documents onto the computer. A problem arises with transforming hard copy shop drawings of various sizes to electronic documents. The small scanner can only scan up to 8"x11" documents, so a wide-format scanner must be used to handle the drawings, which can range from sixteen to thirty-six inches wide. Without this machine in the office, PCC must outsource the scanning of these drawings to a reprographer. Copy Works and Copies Plus in Cedar Falls are the two main sources PCC uses to handle the scanning and copying of wide documents. Besides the cost of the work, valuable time and money is wasted on the

delivery and pickup of the documents (Best). A detailed analysis of the costs will be provided later.

Dealing further with shop drawings, the copying of changes made by PCC on the documents can be made faster and easier with a wide-format combo machine. Presently, when changes are made on shop drawings, numerous copies must be made to file and send to the owner and architect/engineer, requiring drawing the changes sometimes up to eight times. With a machine available in the office, one set of changes can be made by hand and the other seven can be copied and printed. Color printing and scanning capabilities are essential in this area, because changes made be the contractor are often in green, and the architect/engineer changes are usually in red. It is a must to be able to differentiate between the two. The combo machine can save a lot of time and money in this area (Reiter).

Besides issues dealing with project management, the combo machine would be of assistance in the estimating department. Often times, a project may only allow one or two copies of contract documents be made available to the contractors bidding the job. This presents a major problem when more than one estimator is working on putting the bid together. In order to be working on the job simultaneously, they must each have their own set of drawings. Besides needs within the office, numerous subcontractors may also want to look at the drawings to provide a bid for a portion of the work. On nearly every job PCC bids at least one or two concrete, masonry, or painting subs need to borrow a set of drawings to prepare their bid. This presents an even larger problem concerning a lack of drawing copies (Best). With the printer/copier/scanner machine available in the office,

the drawings can quickly and easily be scanned, and copies can be made to help solve the problem.

The implementation of a printer/copier/scanner machine is a very important decision requiring the proper information to ensure an informed decision. With a major financial investment involved, PCC must be sure that all the costs involved with the purchase and maintenance of the machine will be covered over the lifespan of its use. They must also address their specific needs of the machine to ensure they are purchasing a product with enough capabilities but not wasting their money on functions they do not need or want. There are many brands and models available to suit the needs of PCC, and finding the right one for their specific situation is a must. They must be presented with numerous options to choose which one is the best machine for their money.

Cost Analysis

As mentioned, making a substantial monetary investment into hardware for the construction office is an important decision. An in-depth cost analysis of implementing the hardware is a valuable tool to help make an informative decision. The goal of this analysis is to determine the amount of money currently spent on outsourcing the work of a wide-format printer/scanner/copier as well as the costs currently spent on printing on the in-house HP500 ink-jet plotter.

Outsource Costs

The following information is obtained from the financial records of Peters Construction Corporation. The invoice numbers were derived from the actual invoices from the given reprographer in the given year. Pickup and delivery costs take into account the time, mileage, labor, and vehicle needed to deliver and pick-up the materials.

With the help of Brad Best, a cost per trip estimated amount was figured at $25/round trip, based on each round trip taking about ½ hour for the individual and vehicle. There are two round trips per invoice, one each for delivery and pickup, making the total transportation cost $50/invoice. The following information shows the records from 2004-2006 (Peters).

2006 Records

- Copy Works Invoice Totals: $ 3,901.49
- Copies Plus Totals: $ 2,803.52
- Update Plan Room Totals: $ 1,612.02
- **INVOICE TOTAL:**   **$ 8,317.03**
- Copy Works Invoices: 15
- Copies Plus Invoices: 39
- Update Plan Room Invoices: 48
- **TRAVEL TOTAL = 102 x $50**   **$ 5,100.00**
- **TOTAL 2006 COST:**   **$ 13,417.03**

2005 Records

- Copies Plus Totals: $ 5,403.28
- Update Plan Room Totals: $ 665.61
- **INVOICE TOTAL:**   **$ 6,068.89**
- Copies Plus Invoices: 37
- Update Plan Room Invoices: 13
- **TRAVEL TOTAL = 50 x $50**   **$ 2,500.00**
- **TOTAL 2005 COST:**   **$ 8,568.89**

2004 Records

- Copies Plus Totals: $ 5,660.46
- Update Plan Room Totals: $ 698.20
- **INVOICE TOTAL:**   **$ 6,358.66**
- Copies Plus Invoices: 31
- Update Plan Room Invoices: 14
- **TRAVEL TOTAL = 45 x $50**   **$ 2,250.00**
- **TOTAL 2004 COST:**   **$ 8,608.66**

2004-2006 Totals

- **INVOICE TOTAL:**   **$ 20,744.60**
- **TRAVEL TOTAL:**   **$ 9,850.00**
- **2004-2006 TOTAL**   **$ 30,594.60**

In-House Printing Costs

In the years 2004-2006 PCC has printed about 16,200 sq. ft. on the HP500 plotter located in the office. The main advantage to this machine is convenience. Often times, the project managers may want to print only a few pages of shop drawings, schedules, or project plans, and making a trip to a reprographer would be a waste of time and money for such a small job. The problems associated with this in-house process are cost, time, and hassle. The printing costs of an HP500 are extremely high and the print speed is extremely low in comparison to the wide-format laser printers. Also, the machine has a tendency to screw up the printing operation somehow about half of the time, according to Project Manager Larry Reiter. Furthermore, the machine lacks a stacking trey, so the prints simply fall to the ground when completed, creating a large mess in the hallway

when a job consists of numerous pages (Reiter). The following is a breakdown of the in-house printing costs over the past three years.

HP500

- 2004-2006 Volume: 16,200 sq. ft.
- Printing Cost: $ 0.20 per sq. ft. (Rapids)
- Paper Cost: $ 0.06 per sq. ft. (Office Depot)
- **TOTAL IN-HOUSE COST:**   **$ 4,212.00**

Total Printing & Scanning Cost

- **TOTAL OUTSOURCE + IN-HOUSE COST:**   **$ 34,806.60**

Hardware Options

There are numerous options available that could meet PCC's printing, scanning, and copying needs, but the objective is to decide on the one option that meets the needs most economically. Knowing the capabilities of each system allows buyers to understand how each system stacks up to the competition, resulting in an informed final decision. The following table introduces five systems and compares a few of their important capabilities. The five systems being compared are the Xerox 6204 (Rapids), HP Designjet 820 MFP (Hewlitt), Oce TDS320 (Montover), Oce TDS450 (Montover), and the Kip3000 (Kip). The system capabilities studied include machine size, print resolution, print speed, maximum/minimum sizes, scan resolution, scan speed, print and scan color capability, and purchase price. Other important variables not shown on the chart include the maintenance plan and print costs of each machine. The maintenance plan is important because it usually covers the ink, toner, or even paper throughout the term of the plan, also any performance or setup problems associated with the machine are usually covered. Buyers want to associate with a dealer that can tend to problems quickly

and effectively, minimizing down time and headache. This makes the location, experience, knowledge, and ability to quickly help important factors for the dealer. Possibly the most important factor to consider in these machines is the costs involved in printing. Even though the scan and copy functions of the machine are important, the cost savings in printing are what will eventually pay for the machine. In the long run, the machines with lower cost per square foot of print area will most likely be the better option, even with higher purchase prices. The following table compares the five systems.

TABLE 1- System Comparisons

System	Size WxDxH, Wgt.	Print Resolution	Print Speed	Max/Min Sizes	Scan Resolution	Scan Speed	Color Capability	Price
Xerox 6204	52"x22"x43" 536 lbs.	600 dpi	2.36 ips	Max = 36" Min = 11"	600 dpi	3.0 ips	Print – No Scan - Yes	$ 15,929
HP 820 MFP	63"x80"x41" 406 lbs.	1200 dpi	4.8 ips fast mode	Max = 42" Min = 8.3"	2,400 dpi	B 5.0 ips C 1.5 ips	Print – Yes Scan - Yes	$ 19,600
Oce TDS320 Print/Copy	54"x40"x50" 386 lbs.	600 dpi	1.8 ips	Max = 36" Min = 11.5"	NA	NA	No	$ 21,700
Oce TDS320 Scanner	52"x24"x45" 150 lbs.	NA	NA	Max = 40" Min = 8.5"	400 dpi	1.8 ips	No	Included in above
Oce TDS450 Print/Copy	54"x40"x50" 386 lbs.	600 dpi	2.0 ips	Max = 36" Min = 11.5"	NA	NA	No	$ 26,700
Oce TDS450 Scanner	54"x40"x50" 386 lbs.	NA	NA	Max = 36" Min = 11.5"	600 dpi	B 3.3 ips C 2.6 ips	Yes	Included in above
Kip 3000	49"x24"x44" 430 lbs.	600 dpi	1.6 ips	Max = 36" Min = 11"	600 dpi	B 7.6 ips C 2.6 ips	Print – No Scan - Yes	$ 23,000

Printer/Copier/Scanner Analysis

The first thing that needs to be done in analyzing the options is a general overview and comparison of the machines. The scanning and copying capabilities of each machine are very similar. The two noticeable differences are the Oce TDS320's inability to scan in color and the Kip 3000's black and white scan speed being superior to the others. As far as printing goes, the HP is the odd system out, because it is an ink-jet

printer that obviously uses ink cartridges as its print source. The other four systems are laser printers which use toner burned onto the paper for printing, which is completely different than the ink-jet style. As you can see on the chart, the HP has twice the print speed and resolution as the other systems, but the ink-jet printing is much more expensive than laser printing. The ink-jet style of the HP allows the machine to print in color, setting it apart from the toner printers, which can only print in black and white. Besides the advantages already mentioned for the HP 820 MFP, the machine is also an all-in-one package that takes up minimal floor space and the print quality can be adjusted from fast mode to presentation quality (Hewlitt). The big disadvantage, as mentioned, is the cost of printing.

As for the four toner-based machines, they are all very similar in print speed, scan speed, and resolutions. None of them can print in color, and all but the Oce TDS320 can scan in color. The Oce TDS450 and TDS320 are very similar machines other than color scanning, differing slightly in print and scan speeds. What differentiates these two Oce machines from the other two toner printers is that the print and scan machines are separated into two workstations. A disadvantage of this is that it requires more floor space to house the printing and scanning machines together. If space is very limited, this can be a huge deal, if not, this is not a deciding issue. There is an advantage to separate machines; if the scanner goes down, the printer is still available, and if the printer goes down, the scanner can still be used (Montover). In contrast, the all-in-one systems, such as the HP, the Kip, and the Xerox, have interdependent scan and print functions; if one part fails, the whole machine is out of use. This can be a huge deal, especially if a technician is unable to fix the problem immediately. This leads into the service and

maintenance plans of the dealer. The nearest Kip dealer is in Chicago, IL, the Xerox dealer is in Cedar Rapids, and the HP and Oce are dealt out of Waterloo, giving Kip a big disadvantage in this area.

To get a feel for users' opinions on the different systems, we looked at a chat log containing many comments on wide-format machines. It is hard to put a lot of weight on the comments from a chat log, as many of them could be from dealers and partial parties, but there was an overwhelming connection between a majority of the comments. The consensus is as follows. In general, the Kip 3000 has a lot of software problems, requiring constant fixing, but when the machine works the printing and scanning is high quality. The Oce is the best brand in terms of quality, with excellent printing and scanning capabilities and minimal maintenance requirements. The disadvantages are the higher purchase price and the increased space requirement. The Xerox is a steady machine with a lower quality than Oce and a much lower purchase price (Autodesk). There were comments contracting these three generalizations, but for the most part this was the feeling we got from other users.

Now that the systems' capabilities have been analyzed, which one is best for Peters Construction? As mentioned earlier, color scanning and printing capabilities are essential, because a differentiation between the architect's and contractor's markings on shop drawings must be made. This rules out the Oce TDS320 due to no color scanning capability. The majority of printing is in black and white, while the color printing is minimal. To solve the problem of the laser printers' inability to print color, the color printing could continue to be done on the existing HP 500 in the office, and all other printing on the new machine. All of these machines can coexist with the HP 500 without

creating any problems. For Peters' application of the machine, the cost is the main priority, while speed and resolution are not as important. Thus, the HP 820 MFP is not the best purchase because of its expensive printing costs. In the long run, the money saved in printing costs will surpass the extra purchase cost up front. This leaves the Xerox 6204, the Oce TDS450 and the Kip 3000. The problems many have experienced with the Kip, combined with the nearest dealer located in Chicago, make it a questionable purchase. The two machine system of the Oce does not create a big problem for PCC because they have plenty of room in the office to house two machines rather than one. The deciding two factors are quality and cost. Oce is more expensive than the Xerox, but it also is higher quality printing and service. Another advantage for Oce is the dealer is Advanced Systems in Waterloo, less than five miles from the Peters office. Prior dealings have developed a solid relationship between Peters and Advanced Systems, as all the copiers and printers previously purchased have been through them. This ensures that PCC will be taken care of and given a fair price. It is a very serious decision that requires the proper information to make the best choice.

<div style="text-align: center;">*Cost Saving Options*</div>

There are a few important cost saving options offered by the local reprographers that PCC currently does not take advantage of. Simple cost saving adjustments can pay large dividends in the long run, possibly eliminating or reducing the need for time or money invested into the situation. Both Copy Works and Copies Plus offer free delivery of documents to account holding customers. Copy Works provides this service twice per day, no matter how large the delivery (Laity), and Copies Plus offers delivery throughout the day also for a job of any size (Taylor). Furthermore, both places stated that a large

amount of their work is done through electronic delivery from the customer. If PCC has a printing job that needs to be outsourced, they can send the file in pdf format via email to the reprographer, eliminating the need for drop off. As more plans are becoming available electronically through architect websites and online plan rooms, this option will become more popular and beneficial. These two services eliminate the need for drop off as will as delivery, and could hypothetically eliminate all the travel expenses associated with outsourced print work, which were a large portion of the total cost.

Look Ahead

It is difficult to provide an accurate estimate of what the next few years will look like in paperless construction. Will there be a need for hard copy prints at all in the future? With more documents becoming available electronically, how much scanning will the general contractor need to do? Is there a way to eliminate the need for hard copies of shop drawings and pass them from sub to general to architect/engineer strictly electronically? In the distant future, the possibility of total paperless construction will become a reality, but the situation now and for the next five to ten years is not completely paperless. The statistics from PCC's records over the last three years have shown a large increase in wide-format printed volume, and this trend may continue. The total print area for 2006, including outsourced and in-house printing, was about 24,000 sq. ft. Taking an average black and white print cost from the Copy Works and Copies Plus invoices, outsourced printing costs about $0.47 per sq. ft. Using an average sq. ft. print cost of the laser printers analyzed, in-house printing would cost about $0.12 per sq. ft. for printing plus paper. Once again using the invoices from reprographers, an average labor cost of printing is about $0.03 per sq. ft (Peters). In-house labor, accounting for lack of

experience, is estimated at $0.05 per sq. ft. According to Mitch Montover of Advanced Systems in Waterloo, Ia, a wide format machine will last an absolute minimum of six years, but probably ten to twelve years (Montover). The following is a conservative six-year comparison between outsourcing and performing in-house using the same volume as 2006. Assuming PCC would take full advantage of sending files electronically and free delivery, the estimate takes no travel expenses into consideration.

Six-Year Estimate

- Outsource Cost: 24,000 s.f. x 6 yr. x $.47/s.f. = **$ 67,680**
- In-House Cost:
    - Operation + Labor: 24,000 s.f. x 6 yr. x $.17/s.f. = **$ 24,480**
    - Purchase Price: **$ 25,000**
    - Total In-House: **$ 49,480**
- **TOTAL SAVINGS:** $ 67,680 - $ 49,480 = **$ 18,200**

The conservative estimate shows a savings of $18,200 over the next six years. If the volume needs remain the same, the machine will not only pay for itself but will put a significant amount of money in PCC's pocket through savings in printing. Keep in mind this estimate took into account no travel cost, a life-span of the minimum six years, and the most expensive purchase price, so the savings could be severely underestimated.

iSqFt

Construction Software Technologies Inc. was founded in 1993 in Ohio and had an initial focus in the development of takeoff and estimating software. In 2000 iSqFt was born, and represented an opportunity to bring great value to the construction industry. iSqFt is a comprehensive online preconstruction management tool. Its two primary service products are the Private Construction Office and Internet Plan Room. In 2004

iSqFt acquired construction companies such as BuildPoint, USProjects, and BidFax, which led to a further geographic expansion of its services (iSqFt).

Private Construction Office & Internet Plan Room

The Private Construction Office helps general contractors distribute plans, specs, addenda, and other construction documents to subcontractors and suppliers. The Private Construction Office software has the capabilities to limit what content can be seen by whom. This lets contractors take control over the preconstruction processes (iSqFt).

The Internet Plan Room provides subs, suppliers, and estimators with 24 hour access to project information, specs, plans, and addenda. Last year alone 29 million pages of blueprints were downloaded by subs and suppliers. It also provides the tools to do online takeoffs with On Center Software called On-Screen Takeoff, along with being able to view and print plans, specs, and addenda. Today iSqFt is the country's largest provider of online preconstruction management services to the construction industry. Jaye Whitmire from Whitmire Decorating Inc. stated, "We used Dodge for more than a decade before switching to iSqFt. The difference in production and cost reduction has been dramatic. The total cost is less than half of our previous system, and our production has increased more than 35 percent" (iSqFt).

In March 2001, iSqFt partnered with the Associated Builders and Contractors of America. With this partnership they work to preserve internet plan rooms within local markets. iSqFt was ranked first out of construction firms in Inc. magazines fastest growing private companies. In 2005 the companies CEO/president was honored with the Ernst & Young Entrepreneur of the Year award (iSqFt).

With iSqFt general contractors will become more competitive and efficient in the preconstruction process. Contractors will get more bids from subcontractors and vendors while also being able to prequalify all bidders. This can help to reduce travel expenses and reduce printing and distribution costs. But still leaves the option to use paper construction documents with any of the preconstruction process. Bill Michael from the Robins & Morton Group stated, "On bid day, we received over 200 qualified bids without distributing paper drawings! In the past year, we saved our clients more than $100,000 in reproduction and shipping charges (.iSqFt).

Cost and Requirements

The cost of iSqFt is significant at $3000 for an annual subscription, but subscriptions through AGC are offered at a 25% discount to all AGC members. According to allpm.com the Carolina's and Iowa are the biggest users of iSqFt. Vicki Strand of Stetson Builders supply in Iowa says, "her firm uses iSqFt regularly in 8 locations, with the roofing division making the most use of doing material takeoffs. Not all users prefer the system, Paul Lawson who heads up the Texas office of Pepper says, "he still sees a lot of project managers preferring homebred versions of excel for estimating, with little adoption of iSqft in the Houston area." Mark Tritschler, (Executive Vice President of McShane, a national design-build firm based in Rosemont, IL) agrees, "We tested internet plan rooms and have experience with estimating software but find our own custom hybrid forms of excel easier to use for tracking our projects." Many companies agree that getting their employees to work with plans online is a difficulty (Allpm).

Recommended Requirements For Running iSqFt.

Windows XP

Microsoft Internet Explorer 6.0

1ghz Pentium 4 Processor

1024 MB of Ram

5 GB Hard Drive

Cable/DSL Broadband Connection

17" Monitor - 1024x768 Resolution

These requirements can be hard to meet if companies are not constantly updating their software and hardware capabilities (iSqFt).

Electronic Closeout

Many aspects of construction are being changed by available technology. Because the construction industry is usually lagging behind in the use of new technology, electronic closeout is a new and easy way to reduce the amount and cost of paper. Electronic Construction Closeout (ECC) is a new filing method provided by Data Builder, Inc. Two years in a row Data Builder has received the technology Enabler Award from "Constructech" magazine for ECC (Data).

Steps for Electronic Construction Closeout

ECC is broken down into six steps. The first is to prepare and organize a closeout in the same manner that is requested by the owner. Data Builder, Inc. said to include a table of contents and title documents and also to use as few staples and paper clips as possible. Step two is to ship the documents to Data Builder. A tracking device should be

attached to the documents while being shipped. When the documents are received by Data Builder they are stored in a locked and secure area. The third step is the preparation of the documents. This step consists of preparing the documents for scanning by removing all staples and other obstructions to the documents. Step four is the actual document scanning. Quality of the scanned documents is checked and all blank pages are then removed. Step five is data entry, indexing, and quality assurance. The sixth and final step is packaging, delivery, and training. When the final product is delivered, a 30-minute training session is available to show how to use the ECC software according to Data Builder. The turnaround period for this process is approximately four weeks (Data).

There are some major benefits when using ECC. The process is cost efficient. One standard page costs about $0.70 while larger pages cost about $1.80. This may seem too expensive for some people, but the costs of paper, copying, and the personnel to do this job must be taken into consideration. The other major advantage to using electronic closeout software is the time that is saved when retrieving information. ECC has a search engine to locate and also filters to look for relevant and specific information according to Data Builder, Inc. Using Electronic Construction Closeout a person can also zoom, sort, and print pages needed. There is also an option where you can make and track markups for that specific job. Documents compiled by Data Builder, Inc. are also modifiable although the original document always remains. The tags can be changed, information can be highlighted, and all of the documents are printable (Data).

Electronic Project Control System (e-PCS)

Data Builder offers another option for companies to cut down on paper usage is by using Electronic Project Control System (e-PCS). This system allows the contractor

to share documents online with the project team and the owner instead of filing everything in boxes and cabinets. These documents stay online for years after the projects completion. E-PCS drastically cuts down on the time it takes for paper documents to change hands which in turn cuts down on construction costs. When someone needs to approve something or if the document is relevant to a person's job, a notice is sent by e-mail. Iowa State University is currently researching how much time is wasted by the current method of a General Contractor managing these services. The research currently shows that by eliminating this process, e-PCS can bring the General Contractor a process that is four to five percent more efficient (Data).

When paper documents are eliminated the paper and copy costs are eliminated. Storage can also be a problem after many projects are completed when using the conventional closeout documents. By using ECC, about 90,000 sheets of paper and 2,000 sheets of rolled drawings are put into a 5 GB device. This is equivalent to about 35 large bankers' boxes according to Data Builder, Inc. It is also very difficult for employees to find information that must be retrieved because of the massive amount of paper. The condition of paper documents may also not be ideal and misplaced items can also become a problem. There is also only one copy of paper documents so there is the risk of if they are destroyed, there is no back-up file. When individuals try to scan documents to make their own CD, it is not nearly as organized as documents that are sent to a company who specializes in Electronic Construction Closeout. The CD would just name documents and it would not solve the problem of having to search through all of them to find the information needed (Data).

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