SGIA

Industrial Digital Print Markets: North America

An Analysis of User Adoption Practices and Opportunity (Part 1)

Part 1:

Decorative Market

Production Labels Market

Direct-To-Shape Market

Research Undertaken for SGIA by I. T. Strategies, Inc

Industrial Digital Print Markets: North America

An Analysis of User Adoption Practices and Opportunity (Part 1)

Decorative Market • Production Labels Market • Direct-To-Shape Market

Produced for SGIA
www.sgia.org
703.385.1335

Produced by I.T. Strategies, Inc.
http://www.it-strategies.com
51 Mill Street, Suite 2, Hanover, MA 02339
781.826.0200

Industrial Digital Print Markets: North America

An Analysis of User Adoption Practices and Opportunity (Part 1)

Decorative Market • Production Labels Market • Direct-To-Shape Market

Table of Contents

Figures and Tables

INTRODUCTION

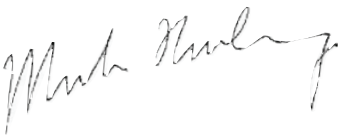
SGIA asked IT Strategies to undertake a mix of primary and secondary research into some established and significant digital industrial print markets to understand what makes people enter the markets, the experience of entering the new markets and the opportunity these markets represent for the future.

At IT Strategies, we have specialized in exclusively tracking the growth and development of industrial and production digital print markets since 1992. For this study we have focused resources on five sectors of industrial markets: decorative, pressure-sensitive labels, direct-to-shape product markings, production textiles print, and wide-format display graphics. These represent the most important digital print markets outside of communications print, packaging and some other more marginal industrial specialties.

Digital technology suitable for strategic insertion into the five markets under analysis is at this time relatively undeveloped at the high end of the decorative and DTS markets, whereas true production technology is available for labels, textiles and display graphics markets. In our research, we evaluate the current status of digital production print, barriers to the North American market and new opportunities for digital.

The focus is on the relationship between the digital and analog production, economics and functionality of digital technology as its initial value proposition, the uniqueness of digital and new developments it brings to the market in terms of new applications, new users and opportunities for brand owners.

The report is organized in two parts. Part One focuses on the decorative print, labels and direct-to-shape markets. Part Two is about wide-format display graphics and textiles markets.



Mark Hanley
President, IT Strategies

Basis of Analysis

We offer a significant amount of statistics and interpretational analysis in this report. It should be understood that with subject matter of this diversity, dynamism and complexity, statistics represent our best estimates. The data behind the statistics and analysis is gathered with care and our sources are excellent, so it is reliable, but there is a margin of error of perhaps 15% at worst (though in most cases it is probably much better than this). Similarly, there is debate around the conclusions to be drawn from the observed development of the market. We have taken what we think is in most cases a conservative view after reviewing diverse opinion, but in the end these are our opinions and are subject to fair debate, and could be subject to revision, alternative interpretation and to challenge in general.

Qualifying Note around User Research

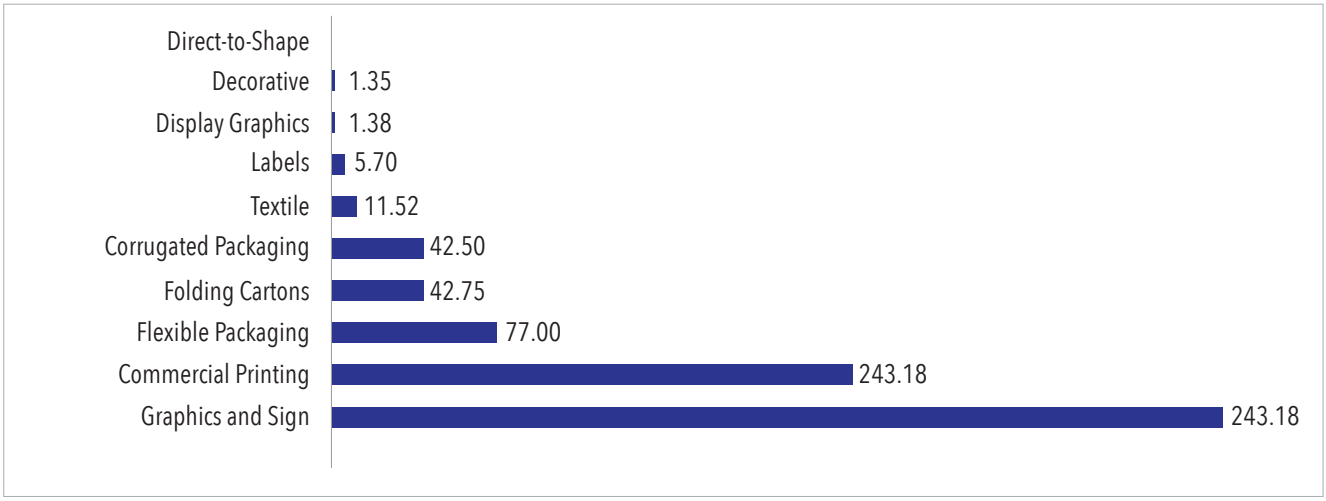
We want to emphasize that a careful reading of our analysis throughout this report will indicate that the scale and positioning of digital print by sector was highly varied with many cases of digital becoming strategic but being small-scale and within a specialized offering. At least for now, even as users may foresee a much larger future and broader offering of digital products. That is, underlying assumptions of the framework questionnaire presuming digital will become an integrated production component within an analog infrastructure of offerings do not correspond in all cases fully to reality. We believe that digital, even as it develops to higher volumes of print and lower costs, may in fact underpin a new model of print which remains for at least the mid-term rather specialized, narrowly focused, and targeted at high value, but taking significantly larger shares of revenue than output, and even more so of profit.

Print Industry Overview

In order to set the industrial print markets in their correct context, Figure 1 quantifies the relative size of the five industrial markets analyzed in this report – decorative print, labels, direct-to-shape (DTS), wide-format display graphics and textiles – in annual square meters of analog or traditional print output in North America – as compared to other large print markets in packaging, commercial printing, and graphics and sign. Physical output as used here is a measure, a unified form of comparison valid for most markets and provides an objective method of comparison. DTS is measured by units of print, not square meters, so DTS data is separately provided in the report section devoted to DTS.

The five industrial sectors that are the focus of our research, taken together with the packaging, commercial, and graphics and sign markets, represent close to 90% of all print markets. The only industrial market of scale we have omitted is ceramic tiles, which did not qualify in light of its heavy focus on China and the fact that it already represents mostly-conquered territory for digital print. It will be seen that the five industrial sectors are orders of magnitude smaller than their packaging, publishing and communications rivals. That is not to say they are in some way objectively small or not excellent production opportunities for digital print. Rather, they operate on a different scale within their own unique current performance and economic envelopes.

Figure 1: Relative Size of North American Analog Print Markets Output, 2017 (Square Meters, billions)

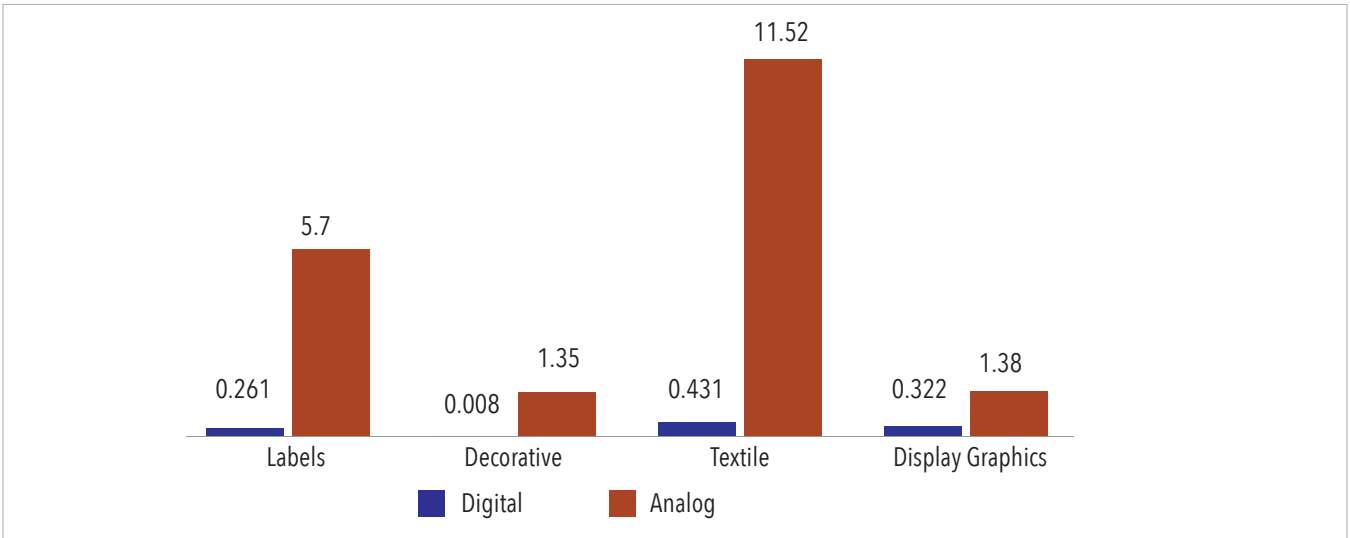


Source: IT Strategies

Industrial Print Markets

The statistics in Figure 2 quantify digital and analog output in annual square meters in the North American market for the following sectors: labels, decorative, textiles and display graphics. If we were to compare digital markets to analog in terms of their relative share of revenue the shares would be larger (three to four times larger in some cases). The share might be even greater if we could compare profitability. Those higher share numbers, when measured financially, are a reminder that when we speak of production markets according to the different business models adopted by different sectors and within sectors, we should be aware of the variety of ways people do in fact measure success or market penetration.

Figure 2: Relative Size of Digital and Analog Industrial Markets Output (Square Meters, billions)



Source: IT Strategies

In digital industrial markets, the model today is most frequently a higher-value/lower-volume model by comparison to traditional analog print markets. That could change over time as markets grow and become more competitive. Even so, that may not mean markets will ever become as commoditized as some analog print markets, with their old model of large masses of identical product. We can say now that among the industrial markets addressed in this report the digital output shares are mostly small and at an early stage of development. Only display graphics, with about 25% relative share of print output against analog, stands out (Table 1).

Table 1: Digital Final Printed Product as Percentage of Analog (Output and Revenue)

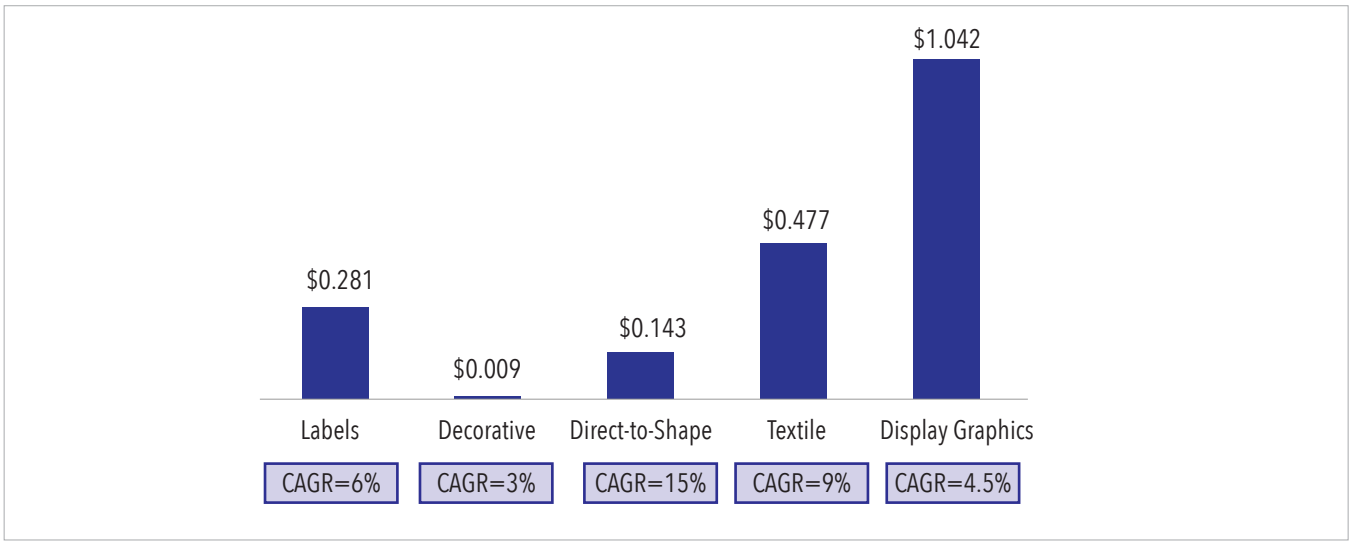
	Digital Final Printed Product as Percentage of Analog	
	Output (BM^2)	Revenue ($)
Display Graphics	23.33%	265.15%
Labels	4.58%	15.00%
Textile	3.74%	6.08%
Decorative	0.59%	1.52%
Direct-to-Shape	N/A	0.50%

Source: IT Strategies

Furthermore, relative share does not necessarily imply direct competition between digital and analog print. In most cases, digital is in fact doing something new and unique, and has to be called a parallel, rather than directly competitive, market. Often digital starts out with a directly competitive rationale in being able to handle short runs with better economics than analog print, but that is not always true, and even where it is digital markets often soon diverge to value propositions around true uniqueness and new markets.

How much do industrial printers spend on digital? As seen in Figure 3, North American digital vendor revenues (hardware and ink) vary by sector, with a total of just over $2B in 2017.

Figure 3: Digital Industrial North American Markets Vendor Revenues ($, billions)



Source: IT Strategies

Primary Research Approach

As a major source for the analysis, we interviewed seven users, two digital vendors at least one brand owner per sector. We used a questionnaire for the primary research directly for users. The questionnaire serves as a guide for vendors and brand owners who were asked about their experiences adopting digital systems and developing digital markets under the following major headings: years of digital market presence in North America, directness of competition of digital to analog, presence in existing analog channel, maximum productive scale vs. analog average, digital market size in North America vs. EU. The summary of individual answers given by users contained in the body of the report follows the schematic of the questionnaire in an abridged format.

The primary research was undertaken on a double-blind basis to ensure openness and remove bias. That means the interviewee did not know who behind IT Strategies was asking, and SGIA and the report reader do not know who is responding outside of generic identifiers provided. The identity of research targets has been concealed and is not intended to be known.

For each industrial market, we provide a graphic status summary. Below is an explanation of the five headings under which we will summarize the status of each market's digital/analog print positioning:

- **Years of Digital Market Presence in North America**
  This is our estimate of how long digital print technology has been commercially present in North America with a strategic, credible, productive offering to this market.
- **Directness of Competition of Digital to Analog**
  Directness of Competition means to what extent digital technology is making a direct argument to substitute analog print technology at some level of product equivalence as opposed to providing an offering going substantially beyond equivalence to analog.
- **Presence in Existing Analog Channel**
  This measures the extent to which digital print technology has been adopted by existing analog print/conversion channels as opposed to parallel channels not previously engaged directly in analog print in this sector.
- **Maximum Productive Scale vs. Analog Average**
  This is an approximate comparison of our view of average productivity rates in terms of print output between representative analog and digital print technology in this sector.
- **Digital Market Size: North America vs. EU**
  This compares the proportion of the existing digital market in North America as opposed to the other early-developing industrial digital print region of EU. We have not included Asia Pacific for reasons of simplicity and because Asian market conditions can be substantially differentiated by comparison to US and EU.

Under each graphic we provide a concise description of the market's status as we understand it from our own industry knowledge and from the primary research conducted for this report.

The sectors researched are so extremely diverse and operate under such different conditions that it was difficult to use a single filter for qualifying interview targets. We tried however in each case to find users with maximized time in market a maximized application of digital relative to the digital positioning of that sector.

Because the sectors analyzed were either new to digital (decoratives, direct-to-shape), had a model of fragmentation (display graphics), had only a limited presence in North America (textiles) or were only just beginning to achieve a higher production positioning (labels), this meant that the questionnaire that in some parts assumed a level of integration and relationship to production analog printing varied in focus. To deal with this problem we decided to focus on the underlying issues of acquisition, calculating ROI, early market development, later market development and vendor relationships underpinning the questionnaire. This was a successful approach.

The report is presented in two parts:

- Part 1: Decorative, Production Labels, Direct-to-Shape markets
- Part 2: Production Textile and Wide-Format Display Graphics markets

PART 1:

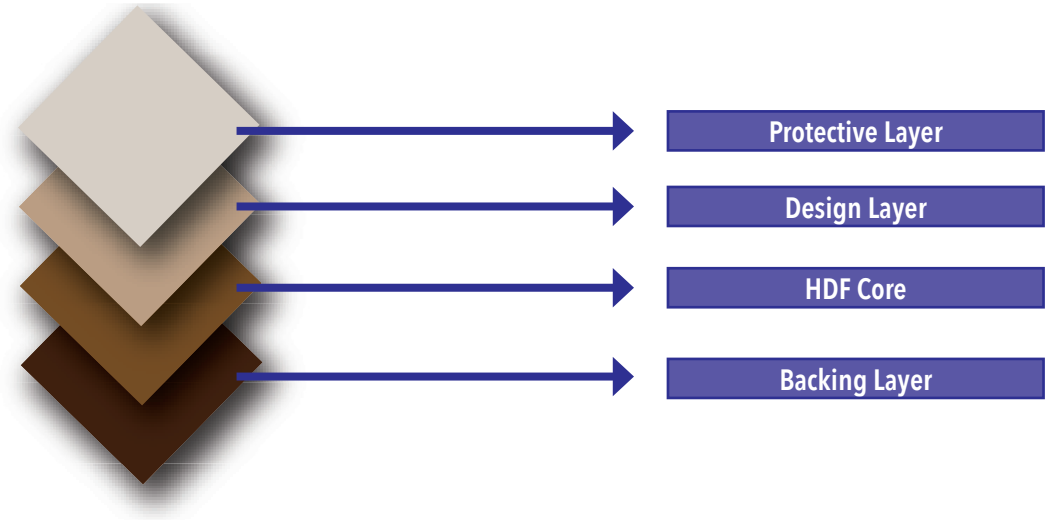
DECORATIVE MARKET

Market Analysis

"Decorative print," for the purposes of the present research, refers principally to decorative laminates used as architectural surfaces for floors and furniture. We have also included wallcoverings, which have become a digital focus area. Laminates are either gravure printed in web format as paper substrates for later impregnation and integration to rigid manufactured laminates, or they can be printed as rigid substrates after lamination. Wallcoverings are also predominantly, though not exclusively, gravure printed in web format. Digital print is undertaken with aqueous Inkjet and UV Inkjet systems in roll-to-roll and flatbed format.

A decorative laminate is a relatively economic rigid architectural surface constructed by laminating layers of paper that have been impregnated with liquid resin (plastic) and formed and cured under heat and pressure into rigid sheets sometimes with a rigid medium- or high-density fiberboard (HDF) core (Figure 4). There is often, but by no means always, a printed layer close to the top of the laminate, which is placed immediately under a transparent protective final layer to provide the decorative part. These are sold into the commercial construction industry and to consumers under the brand names of companies that specialize in selling architectural surfaces, such as Wilsonart or Mohawk in North America. These laminates are used for floors, walls, partitions and furniture.

Figure 4: Diagrammatic Representation of the Parts of a Decorative Laminate Floor Surface



Decorative laminates, when they have a printed "design" layer, are usually gravure-printed in reel format and as gravure implies it is usually done at high run lengths and there is a fixed pattern repeat length corresponding to the diameter of the etched cylinders. Competitive to printing of a sheet as part of the integrated rigid laminate is foil print, printing of a paper sheet laminated to a clear foil layer that is subsequently attached to a rigid architectural surface like a medium- or high-density fiberboard. That is sometimes lower cost than generating the whole rigid surface as an integrated entity. The decorative laminates market is historically considerably less-developed in North America than in say, Europe, where there is a higher preference for laminates (Table 2).

Table 2: North American Digital Decorative Market Positioning

Years of digital market presence in North America: 3 – non-mainstream production

Directness of competition of digital to analog (equal validity, but untested)	
Better digital economics at low scale = directly competitive to analog	Uniqueness of digital offering
Presence in Existing Analog Channel	
Digital integrated to analog channel	Separate parallel digital channel
Maximum Productive Scale vs. Analog Average	
300 M^2/H digital non-dedicated wide-format systems	50,000+ M^2/H gravure
Digital Market Size: North America vs. EU	
North America	EU

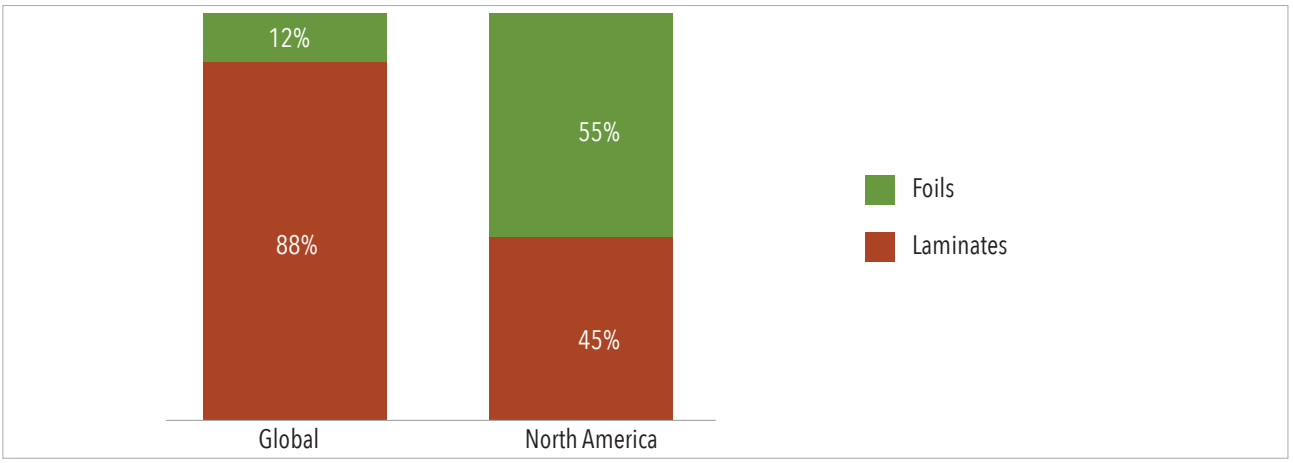
Source: IT Strategies

Market Status

Decorative Laminates

The global decorative laminate print market is about 9 billion square meters (96.9 billion square feet) of which foils are about 12%, and the rest are integrated laminates (88%). Of the laminates about 12% are for flooring and 88% for furniture (the industries see themselves as separate as well). The North American market has a different structure and makeup compared to the leading European market. For example, the place of low-pressure melamine laminates in North America is significantly smaller. In North America there are around 1.35B square meters (14.35 billion square feet) of printed laminates of which around 55% are foils (Figure 5). That makes North America about 15% of the world market for printed decorative laminates of all kinds. The North American market grows at around the pace of the construction economy (1–2%). The rate of growth is higher for digital than for analog equipment (Table 3), and the ratio of digital-to-analog is on the rise for the final output and even more for the revenues (Figure 6).

Figure 5: Decorative Laminate Structure: Global vs. US



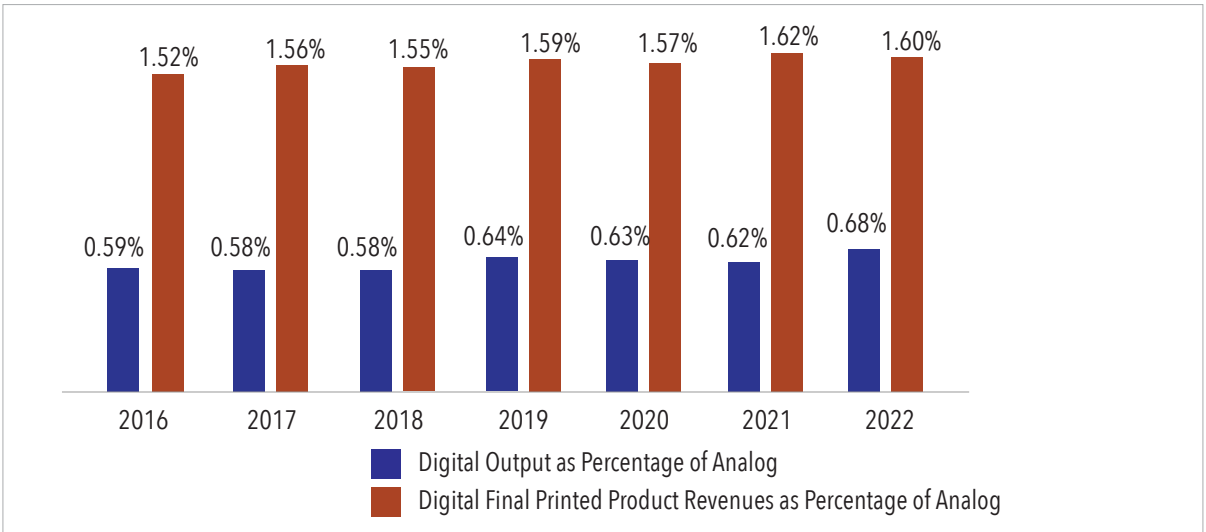
Source: IT Strategies

Table 3: Decorative Laminates - Analog vs. Digital, Output and Revenues, Forecast (North America)

	2016	2017	2018	2019	2020	2021	2022	CAGR
Analog Printed Product Output, BM²	1.350	1.370	1.390	1.410	1.430	1.450	1.480	1.50%
Digital Printed Product Output, BM²	0.008	0.008	0.008	0.009	0.009	0.009	0.010	3.00%
Analog Printed Product Revenues, $B	1.650	1.670	1.680	1.700	1.720	1.730	1.750	1.00%
Digital Printed Product Revenues, $B	0.025	0.026	0.026	0.027	0.027	0.028	0.028	2.00%

Source: IT Strategies

Figure 6: Decorative Laminates – Digital Output and Revenues as Percentage of Analog, Forecast (North America)

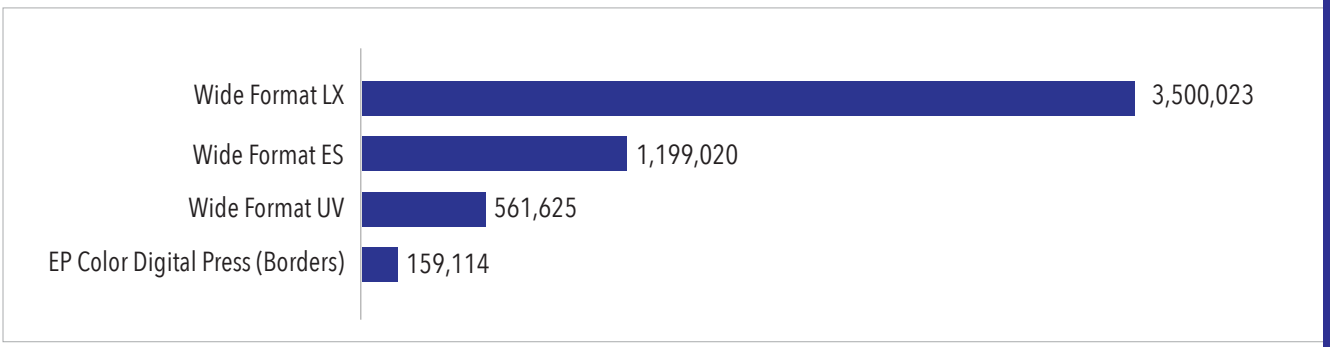


Source: IT Strategies

Wallcoverings Market

The digital wallcoverings market is an as-yet small, but distinct, sector where there is roll-to-roll print as well as much use of cut wall graphics with removable adhesives. The market is an offshoot of the wide-format graphics market, and systems are sold for this purpose, those using latex inks, whose advantages in being odorless are considered strong in this market (Figure 7).

Figure 7: Wallcoverings Digital Print Market, Square Meters (2016 est.), North America



Digital growth rate 15%+
Ratio, digital to analog output of wallcoverings = 2.4%
Source: IT Strategies

Digital Technology Formats, Scale and 5-Year Targets

There are three formats of digital print technology that touch on the laminates market and one or two that in wallcoverings. In laminates there are custom-built large-scale production systems deploying aqueous Inkjet at high widths and throughputs used among the major paper laminate printers in Europe. These systems are at an early stage of development and their specifications and performance are not stable yet, though early volumes are being printed. Then there are paper and rigids printers being built by board manufacturer suppliers in Europe and being offered higher up the value chain to board manufacturers to print products which are or are not the print quality equivalent of traditional laminates depending on whom you ask. But these systems have developed a modest real European market (60 million square meters). And finally, there is some very small-scale experimentation in the US among brand owners deploying non-purpose-built flatbed display graphics systems to print rigids on-demand.

In the laminates sector there is discussion among the major laminate printers of deploying successful digital print systems in North America. They may do that or just import digital print from their European base.

In wallcoverings small- and large-scale roll-to-roll systems are deployed among specialist and non-specialist local PSPs who sell parallel to the traditional wallcoverings supply chain to designers and event-/retail-driven constructors. This wallcoverings market will most likely grow organically within existing infrastructures.

Digital Value Proposition

The value proposition, as agreed upon by most of the people we talked to, lies in making frequent design changes available to users in a gravure-dominated laminate and wallcovering world where minimum quantities and costs for design change are prohibitive. Brand owners agree with this idea of the value proposition, but opinion was somewhat divided among suppliers as to how much latent demand there really is in North America for a hipper laminate offering in a market that traditionally associates value with natural materials rather than laminates. We feel this may be an overly conservative position for suppliers to take and risks the development of another parallel market for digital in defiance of the idea that only established laminate printers are able to develop production digital print solutions.

Positioning of Analog and Digital Print Today in Decorative Laminates

There is a very low volume of digital print of decorative laminates in North America today, and that which is done is done mostly (perhaps entirely) on essentially non-dedicated flatbed and roll-to-roll systems repurposed from the wide-format graphics markets to serve a small high-end specialty market driven by décor brand owners including large companies like Wilsonart and Armstrong and a range of smaller startups who sometimes print themselves and sometimes use contractors.

The best way to describe digital print's status is experimental, starting out in sampling, edge print and moldings. There are also small quantities of digitally printed laminates coming into North America from Europe printed by board manufacturers on Hymmen systems. This status is somewhat (but not a lot) behind that in Europe, where there is some dedicated (using dedicated European print systems) volume print of both laminate paper and top print on rigid surfaces (maybe about 60 million square meters (646 million square feet)).

In Europe, all the globally-dominant traditional laminate printers are working on production digital systems and are still at an early stage of development, though there is some production print there. There is also said to be a machine, from a major US digital print vendor, with a 49-inch width for laminate paper.

There is real difference of opinion in the current debate as to whether the up-value-chain printing of laminate paper and rigids will be perceived over time as of equivalent quality to traditional laminates by users. One of the major issues involved in developing these systems has been the need to adapt existing gravure inks to inkjet, because the inkjet-supplied inks caused major issues of metamerism (color changing under varying ambient light sources).

Primary Research Analysis: Interview Targets within Decorative Environments

Because the North American market for decorative laminates is substantially unaffected by a strategic digital print initiative to date, we have focused on major analog printers in North America meeting the following criteria:

- Their European operations are beginning to become involved in digital.
- Their existing leadership role in North America is likely to allow them to be digital market initiators.
- Their knowledge of digital and role as market leaders in bringing it to market are likely to be significant.

We have also interviewed larger converters who are involved in digital wallpaper printing and have included a front-end board manufacturer/brand promoter in the laminates field (Table 4).

Table 4: Summary of Decorative Market Interviewees

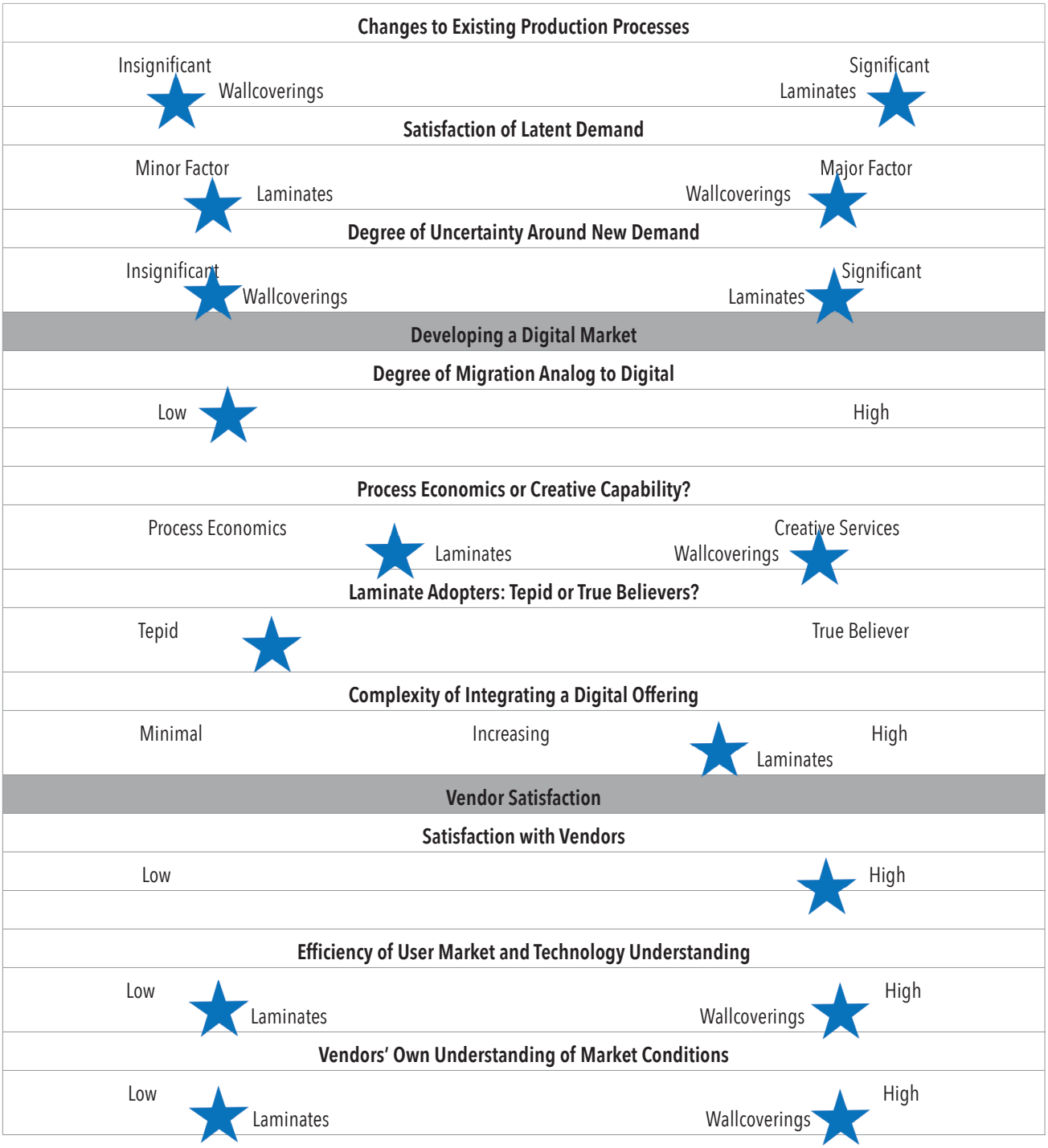
#1 thru 4 Leading global decorative laminate printers (US/EU Management, EU companies), three were interviewed directly		
Estimated revenues $300-750 million	Some in Production Digital	Dedicated-to-purpose roll-to-roll aqueous Inkjet (EU)
#5 US HQ of leading global manufacturing of flooring board EU/US		
Estimated revenues over $350 million	5 years in Digital	Dedicated flatbed UV inkjet and roll-to-roll UV Inkjet production technology in EU
#6 Small-scale wallcoverings specialist provider in Northeast US		
Estimated revenues $6 million	8 years in Digital	HE roll-to-roll Inkjet technology, some ES and UV, screen print as well
#7 Dutch mid-size interior surfaces contractor provider with US HQ		
Estimated revenues $88 million	6 years in Digital	Hybrid high-end and stand-alone UV Inkjet production technology

Digital Acquisition

In order to better understand the development of digital print technology in the decorative market, we analyzed the adoption process of digital: its length, sources of information, changes to the existing process, ROI expectations and vendor satisfaction (Table 5).

Table 5: Laminates/Wallcoverings Digital Acquisition – Research Schematic Summary

Laminates/Wallcoverings Digital Acquisition – Research Schematic Summary			
Technology Acquisition			
Sales Cycle to Acquisition (wallcoverings only)			
6 months ★	1 year	2 years	3 years
Due Diligence Format			
Publications	Trade Shows ★ Wallcoverings	Peers	Vendor Commitment ★ Laminates
Financing Mode			
Cash	Self Finance ★ Laminates		Bank Finance ★ Wallcoverings
Amortization Period			
1 Year	2 Years	5 Years ★	10 Years
ROI			
Accuracy of Model (wallcoverings only)			
Poor			Comprehensive ★
Missing Inputs with Hindsight (wallcoverings only)			
0% ★			100%
Degree of Continuing Confidence in Investment (wallcoverings only)			
0%			100% ★
ROI Achievement Period (wallcoverings only)			
1 Year	2 Years ★	5 Years	10 Years
Early Market Development			
Net Process Cost Increase Because of Digital			
Reduction	Neutral	Some Increase ★	Large Increase



Technology Acquisition

Among mainstream laminate printers there is conservatism, but also a sense that a digital production system suited to their needs has not been available and so they have turned to integrators to develop purpose-built systems. These kinds of systems are few and are at a trial stage. There are in Europe adopters of custom-built systems of among board manufacturers further up the value chain, which print laminate papers as well as rigid substrates. That is a moderately successful specialist market for systems that do not appear acceptable to the mainstream laminate printers. In wallcoverings markets the systems are small- to mid-sized and largely adopted by startups coming from the design community. They also emerge among brand-owner interiors suppliers and represent a undeveloped market that's not essentially competitive or much related to the existing gravure-printing wallcoverings industry.

ROI

Among the major laminate printers, adopters of purpose-built presses are at a stage of early investment, prior to return on investment (ROI). Among the up-value-chain board manufacturers, ROI is a function of using digital print to integrate out of printer-dependence to a small extent, and to offer enhanced services. In general, that has been a positive European experience waiting to be repeated perhaps in North America, but this is a broad definition of business re-positioning beyond simple print ROI within an existing print environment. In wallcoverings, the principal activity is for startup or brand creative companies to adopt digital on a relatively modest scale from scratch in a new business and leverage the creative front end of their businesses with it. This also is ROI in the context of expansion of a whole business model and has led to satisfaction with the returns on digital.

Early Market Development

For the mainstream traditional laminate printers, a market of significant size has not yet developed. For the up-value-chain board manufacturers a market has developed in Europe which is reported to have an output of 60 million square meters, which, if true, is significant and points to latent need among users for a customized or fast response product in laminates. It does not necessarily mean that North America will follow the European model, but neither should it be excluded. In wallcoverings, the market is again not very large but is vibrant, fast growing, high value and fully digitally integrated to creative market response.

Developing a Digital Market

There is no developed market for production digital among mainstream laminates printers, and it is only at an early stage among up-value-chain board manufacturers. In the laminates industry overall, opinions are still divided about the place of digital, although there's no doubt that it must and will evolve. Mainstream laminate printers feel that digital will involve a complex integration of analog and digital technology in a single, but more complex, factory environment. In wallcoverings, the market is still a specialty niche, but given its commercial underpinnings in retail and hospitality for example, it seems likely to become a much larger market.

Vendor Satisfaction

The experience with vendors is limited in all parts of the decorative surfaces market, but so far, whether in a full production/customization mode or just in the mode of buying non-purpose built wide-format decorative-capable systems, no one has anything negative to say about vendors. In every case, this has to do with vendors having identified themselves closely with the applications whether through marketing skill as in the case of wallcoverings or legacy market presence as in the case of laminates.

Current Status of Digital Production Print in Decorative Market

Level of Development

The structure and supply chain of the mainstream decorative print industry suggests that a centralized high-volume digital production model will be preferred and most easily implemented. All major global printers supplying North America have undertaken initiatives but have not reached a stage of implementation due to outstanding economic and technical issues. There is also difference of opinions around the model of adoption as either a specialty adjunct or a more mainstream innovation. The problems are not mostly digital technical issues, rather they are integration and economic issues. In wallcoverings, on the other hand, available technology is fully qualified to support initiatives which are from parallel channels to the analog channel on a distributed supply low volume high margin and specialization model.

Digital Market Relationship to Analog

As implied above, the digital markets in mainstream decorative print of products such as laminates are fully dependent on adoption by existing analog printers and their supply chains. In wallcoverings, the success of digital print had been based on an opposite model of parallel low-volume, high-margin activity.

Satisfaction of Users

Users in mainstream laminate and flooring markets have minimal access to digital to date, so we cannot judge success there yet. But at the same time, the users are not able to access new designs in short runs easily, so it could be argued that existing analog users are dissatisfied in the absence of digital. In the case of the wallcoverings users, there has been a very positive reaction to the availability of design and economic flexibility of digital.

Economics and Functionality at the Very Low End is the Initial Value Proposition

Today in laminate and flooring markets dominated by long-run gravure print technology, the argument for short run on an economic basis is very strong and is anticipated to become a big driver for digital. The same has been true and proven for wallcoverings, albeit on a lower scale of response.

Digital Uniqueness Evolves New Applications, Users and Links Directly to Brand Owners

Decorative markets are built on esthetic response to design, and design inherently creates new markets for more new designs. Therefore, all progress in digital decorative printing is in developing new markets for smaller and more frequently-buying customers based on essentially creating many new and small markets.

Barriers to the North American Market

Underdeveloped Consumer/Commercial

There is some evidence that at the front-end retail/brand level, the decorative markets of laminates and wallcoverings there may be unsatisfied demand for a much greater diversity of design, including latent demand among user groups that are not traditional laminates or wallcoverings customers. If so, that would be a good example of an underdeveloped market waiting for a parallel digital print market channel in the potential future absence of offerings from the existing channels. Alternatively, it is open to the existing print channel to soak up such demand if it is indeed there. Printers in that channel would argue, perhaps correctly, that only they can match the quality standards necessary.

Immaturity of Digital Print Technologies

Digital inkjet print technologies, whether aqueous, solvent or UV, are still at a relatively early stage of development, while electrophotographic (EP) technology is more mature, but has throughput and complexity limits rendering it arguably inapplicable to many industrial markets. Inkjet's development issues relate to large-scale integration in single-pass format, economics of high-volume print, ink/substrate compatibility and lack of a higher-scale infrastructure of general inkjet engine integration skills. Inkjet may therefore be expected to reach much more advanced levels of economic and physical performance in the future.

Projected New Opportunities

Process Substitution

In the decorative laminates industry, most major legacy print participants seem to have major purpose-developed production initiatives in digital print underway in Europe. This, in its own right, holds the potential to transform the range and frequency of design in the industry in a North American market arguably overdue for rejuvenation. However, there is debate about how far this can or should go among the current suppliers.

Major Takeaways

The decorative market is at an early stage. The most mainstream pre-existing analog decorative print market around traditional laminate printers is at the earliest stage of development. Where digital print has come to market among up-stream board manufacturers of laminate surfaces and among creative/brand owner interior resellers, it has satisfied latent demand quickly with a clear and differentiated offering that suggests a much larger market down the road. The decorative market is specialized and will proceed forward successfully in proportion to the extent that vendors and suppliers move within the interiors industry.

LABELS

Market Analysis

The mainstream label market targeted by digital printing technology is for pressure-sensitive labels mostly used on primary packaging in the consumer goods market. Labels like this are generally printed in narrow web format up to around 20 inches wide on combination print and conversion presses at speeds of up to 750 linear feet per minute. The commonest form of print is flexo UV, allowing for immediate in-line conversion. Combination presses are modular, allowing multiple print processes such as offset, screen and gravure to be included, and the same is true for multiple conversion processes, which can include lamination, varnishing, die-cutting, embossing and foiling.

Reels are printed, converted as far as possible in-line, then often slit down to reels that can be inserted into a simple label applicator (typically) at the end of a packing line. Pressure-sensitive labels are high-value and sophisticated print products that have been around for decades, and their use still grows. They have become enormously popular over time, because they give manufacturers a means to communicate and advertise almost on-demand and largely freed from the constraints of packaging and filling processes. Overall, digital printing of prime labels is a long-established production digital market fully integrated into the existing analog label converter channel (Table 6).

Table 6: North American Digital Label Market Positioning

Years of Digital Market Presence in North America: 20+

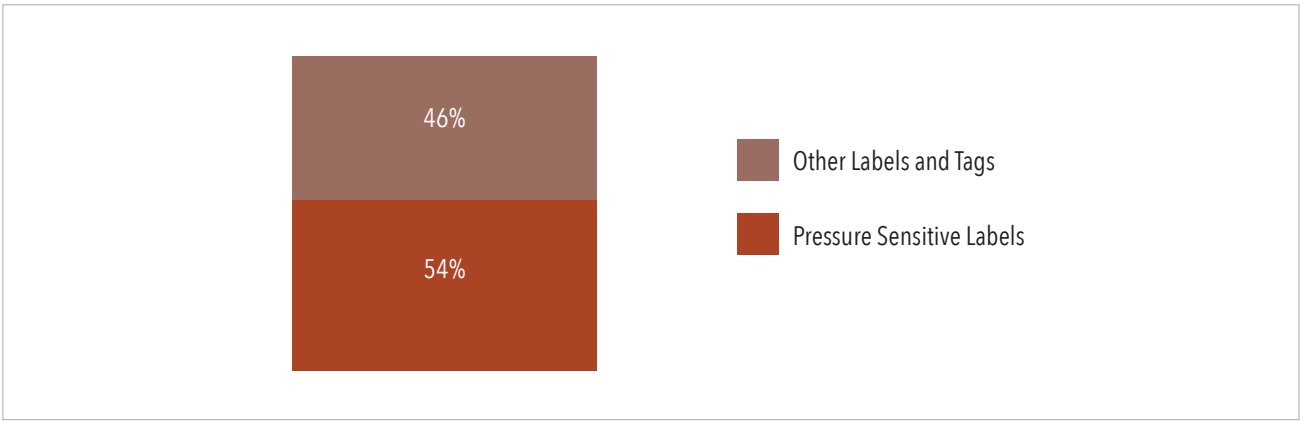
Directness of competition of digital to analog (Equal validity, but untested)	
Better digital economics at low scale = directly competitive to analog	**Uniqueness of digital offering**
Presence in Existing Analog Channel	
Digital integrated to Analog Digital Channel	**Separate Parallel Digital Channel**
Maximum Productive Scale vs. Analog Average	
4,500 M²/H Digital High Average	**6,000 M²/H Flexo**
Digital Market Size: North America vs. EU	
North America	**EU**

Source: IT Strategies

Market Status

The pressure sensitive label market in North America generates around 5.9B square meters (63.5 billion square feet) of output, which is about 30% of the global market with a value in converter billings of around $10.5 billion. Pressure-sensitive labels, the leading label type, represent about 54% of the total labels market (Figure 8). The rest of the market consists of specialty, legacy markets and non-adhesive sheet-printed labels for glue-application (mostly for beverages). The pressure-sensitive market grows at a little over 3% per year (Table 7).

Figure 8: Labels Market (North America)



Source: IT Strategies

Table 7: Analog and Digital Output and Final Printed Product Revenues, Forecast (North America)

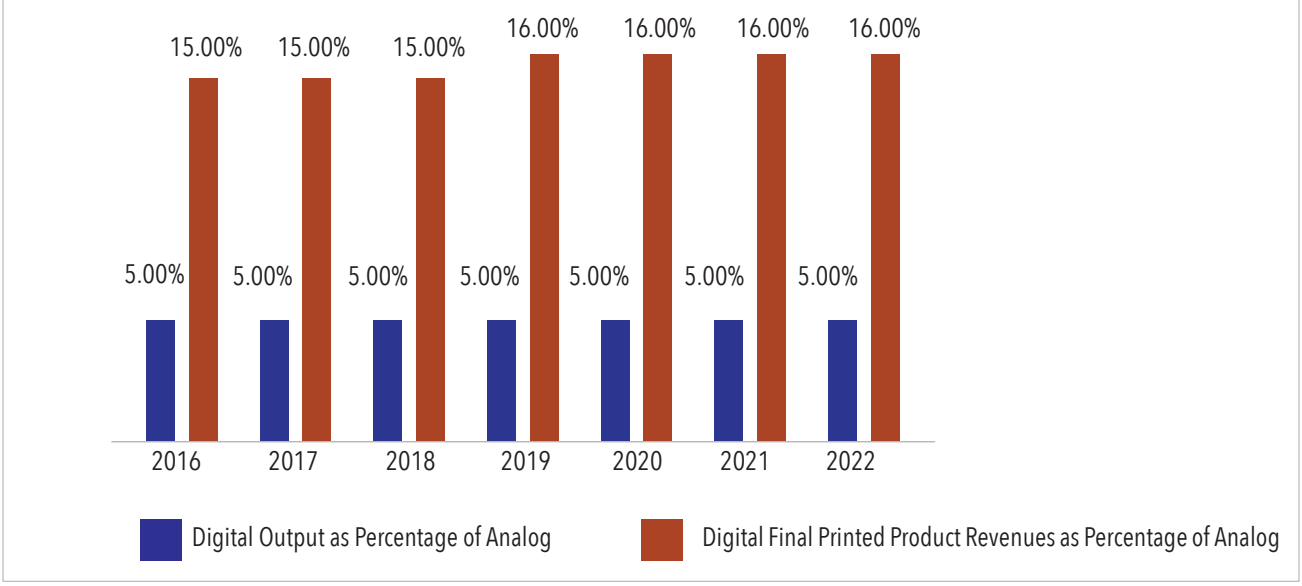
	2016	2017	2018	2019	2020	2021	2022	CAGR
Analog Printed Product Output, BM2	5.70	5.90	6.11	6.32	6.54	6.77	7.01	3.50%
Digital Printed Product Output, BM2	0.26	0.28	0.29	0.31	0.33	0.35	0.37	6.00%
Analog Printed Product Revenues, $B	10.50	10.82	11.14	11.47	11.82	12.17	12.54	3.00%
Digital Printed Product Revenues, $B	1.58	1.65	1.72	1.80	1.88	1.96	2.05	4.50%

Source: IT Strategies

Digital printing of prime labels is a long-established production digital market well integrated into the analog label channel. The appeal of digital labels is fundamentally related to the ability of digital print to provide a lower-cost solution for increasingly-important demand-driven short runs of labels (e.g., 10,000 labels and less). Physically and functionally, digital labels have broad equivalence to analog printed labels.

Digital labels are not economically competitive above fairly short run lengths, and hence the relative output of digital to analog labels is around the 5% level. That said, revenue-relative yields are around 15% (Figure 9), indicating the ability of digital labels to bear high value based on fast response, some exploitation of short runs to satisfy versioning needs otherwise difficult for analog print, and sheer flexibility in being able to cover short-term low-volume demand – which probably was rarely requested or supplied prior to digital.

Figure 9: Labels – Digital Output and Revenues as Percentage of Analog, Forecast (North America)



Source: IT Strategies

This sector is growing healthily in terms of systems sales and average output (Table 7). This growth may come to be fed by the recent (last 2 years) re-emergence of the hybrid sector, which combines digital and full analog print/conversion functionality in high-end systems.

The bottom line on labels is that this is a case study in competitive integration of production digital print to an analog print market and channel, but it's limited by reliance on process cost improvements which only work at the low end for this industry. The market is also perceived to have a tiered supply structure lacking in some aspects full equivalence between digital offerings – perceived non-equivalence. The upside potential in production digital labels is significant but could involve a change in business model and economic basis in order to further scale upwards beyond the established growth rate.

Digital Technology Formats, Scale and 5-Year Targets

Digital technology is available in EP and UV Inkjet format at throughputs approaching analog averages in full production mode. There are now also entry-level products at lower acquisition costs as well as hybrid systems at the top of the market combining true analog production with full digital capability inline. The share of digital is limited less by the physical sale of the technology than by the running cost constraints inherent in the business models of the vendors allied with the complexity of integrating full conversion at high volumes (partly addressed by hybrid systems).

Digital Value Proposition

Labels is a good example of a market in which, even after 20 years, the economic driver of lower cost and faster production availability of small amounts still predominates. Nevertheless, it is believed that as markets develop they turn more and more towards new users and applications – thus more versioning, more creative contone graphics, more smaller-scale customers at higher prices (who in some cases were not previously label customers). Over a longer period, of course, there is the real hope of spreading variable data printing to the packaging and label markets with the hope of a higher price for a more efficient product including managing complexity, but those days are not here yet.

There is a recent trend to provide digital low-end production systems to converters including those below the top 20%, as well as to introduce higher production stand-alone and hybrid systems to the top 20%. If these trends are successful, the result will be to extend the market downwards and potentially to significantly accelerate and raise digital's share of the market in the higher-production environments.

Primary Research Analysis: Interview Targets within Label Environments

We have targeted adopters of both existing stand-alone production technology, newer hybrid systems and also low-end entry-level production systems. The fragmentation of the label conversion market is too diverse in its applications to be able to say that our choices are fully representative, but they do represent mainstream adoption trends for production digital technology (Table 8).

Table 8: Summary of Label Market Interviewees

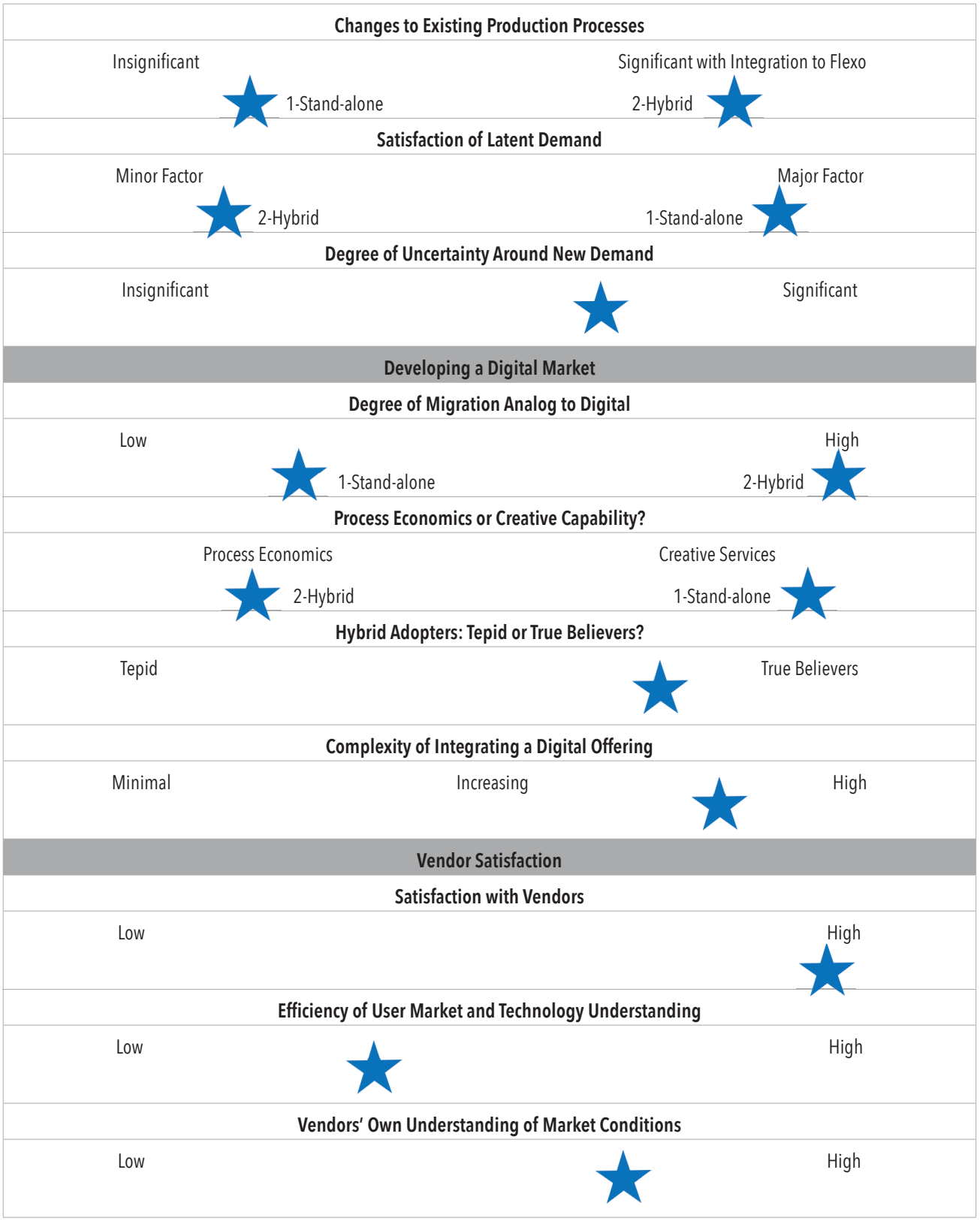
#1 Mid-size general pressure-sensitive label converter, Midwest US		
Est. revenues $9 million	4 years in Digital	Stand-alone high-end production technology
#2 Mid-size general pressure-sensitive label converter, Western US		
Estimated revenues $8 million	<2 years in Digital	Hybrid high-end production technology
#3 Mid-size pressure-sensitive label converter, Midwest US		
Estimated revenues $10 million	<2 years in Digital	Hybrid high-end production technology
#4 Mid-size sector-specific label converter, Midwest US		
Estimated revenues $7 million	8 years in Digital	Hybrid high-end and stand-alone UV Inkjet production technology
#5 National comprehensive PS label converter		
Estimated revenues $400M+	10+ years in Digital	Hybrid high-end and stand-alone UV Inkjet and EP production technology
#6 Large general PS converter Western US		
Estimated revenues $30M+	2 years in Digital	Stand-alone Inkjet technology
#7 Midwest us general PS label converter		
Estimated revenues $10M+	2 years in Digital	Multiple stand-alone Inkjet production technology

Digital Acquisition

To better understand the development of digital print technology in labels market, we analyzed the adoption process of digital: its length, sources of information, changes to the existing process, ROI expectations and vendor satisfaction (Table 9).

Table 9: Labels Digital Acquisition – Research Schematic Summary

Labels Digital Acquisition – Research Schematic Summary			
Technology Acquisition			
Sales Cycle to Acquisition			
6 months	1 year	2 years ★	3 years
Due Diligence Format			
Publications	Trade Shows	Peers	Vendor Commitment ★
Financing Mode			
Cash	Self Finance		Bank Finance ★
Amortization Period			
1 Year	2 Years	5 Years ★	10 Years
ROI			
Accuracy of Model			
Poor		★	Comprehensive
Missing Inputs with Hindsight			
0%	★		100%
Degree of Continuing Confidence in Investment			
0%			★ 100%
ROI Achievement Period			
1 Year	★ 2 Years	5 Years	10 Years
Early Market Development			
Net Process Cost Increase Because of Digital			
Reduction ★	Neutral	Some Increase	Large Increase



Technology Acquisition

Acquisition habits often involve long searches running into years in some cases which in the case of the most expensive and productive equipment can involve users requiring vendors to prove their systems' capabilities for specific applications. Actual sales cycles are somewhat shorter once a user has focused on specific equipment. But there is limited peer-to-peer research and relatively little importance attached to trade shows. Bank financing is common and reflects the highly local established and trust-based relationships users have with their financial institutions irrespective of technology risk.

ROI

Most adopters estimate ROI as they go, starting from a rudimentary base but accept this lack of certainty as part of the digital journey. Non-first-time adopters feel more confident about their calculations. In general, it is accepted to be a very inexact process, and everyone has developed different methods and inputs, which incorporate a lot of latitude in estimating. Acceptable digital ROI is assumed often in a wider context to imply improved economics on existing analog technology and is seen to be achieved relatively quickly (often within one to two years).

Early Market Development

In the entry-level production sectors among smaller converters users are just glad to have economically-accessible technology to address new but small local label markets and to relieve the economic scale constraints of analog technology. There is still a lot of latent demand in this part of the market, which has not had effective digital access until the past three to five years. In the upper sector of the label market, adoption has been and remains a journey of discovery around performance and suitable markets/products for users and vendors alike, and it is becoming more technically demanding and costly as an investment in both respects.

Among all adopters interviewed, there is a perception of the mainstream importance for the future of adopting digital, alongside a sense that it needs to and will become a significantly more productive and a lower-cost technology. For most people, including users and often vendors, the adoption process has involved and continues to involve many performance and economic unknowns, but that is accepted by most without substantial discontent.

Developing a Digital Market

Adopters all say that to a greater or lesser extent they have migrated existing demand for analog labels onto digital technology usually for economic reasons, but these quantities are relatively small. After an initial phase most adopters also report that subsequently growth tends to come increasingly from new users and applications. Digital enables some users to be creative through design services with new customers who may never have used labels before. This is a local, new, small business-driven type of demand which integrated design and print with a digital press renders easy to respond to with instant and (relative to analog) low-cost availability of digital samples and order amounts.

At the high end among hybrid adopters our sample seems to be split between enthusiastic mixed analog/digital market developers and those who see the hybrid as a convenient, extra-modern flexo press with digital available on a more reactive basis. This latter attitude has something to do with outlook, but also something to do with the next point below.

Frequently during the interviews, we would hear about complex jobs that greatly exceeded the assumptions made about the suitability of digital for those jobs – perhaps because of their short length or flexo plate-usage – and the complexity would be perceived by users to exclude digital unexpectedly.

Vendor Satisfaction

Perhaps because of the fragmented nature of the label market, but also because users accept to be quite vendor-dependent, there does not appear to be a lot of peer interaction around digital, resulting in a certain competitive and economic inefficiency. Adopters commonly say they have found the run-cost economics of digital to be unpredictable, and they more or less hold vendors accountable for not their knowing this better in advance as well as for their subsequent inflexibility in accommodating the consequences of this economic unpredictability. Some adopters say vendors do not themselves fully understand physical performance parameters of their own equipment under real conditions, though a few vendors got extra high marks for learning pre-sale about this.

Current Status of Digital Production Print in Industrial Markets

Level of Development

EP and UV Inkjet technology are well accepted for print quality and production process in the labels market. Aqueous latex Inkjet and some pure aqueous systems are accepted for entry-level production. UV Inkjet is now beginning to be accepted for full hybrid combination flexo/digital presses. Some vendors have also reached a high level of integration to production inline following the analog model. Print technology in itself therefore does not represent a technical barrier to further development of the label production market.

Digital Market Relationship to Analog

The prime label market is one of the few digital production markets that has been truly integrated to the analog channel and process. However, as a business model, digital has not even reached a 10% output penetration – although revenue relative penetration is closer to 15% now. So, as is typical of digital production markets, digital follows a path of lower volume and higher margins, pursuing special markets and new markets to a large extent beyond just processes, with economic value propositions taking the pressure off short-run flexo.

Satisfaction of Users

Users are satisfied, although it is only recently that entry-level digital products have addressed the 80% of converters who do not want to spend more than $250K on equipment. But at the high end of the market, among the top 20% of converters, the desire is if anything for higher production systems, within a model so far that suggests possibly a hybrid analog/digital combination.

Economics and Functionality at the Very Low End is the Initial Value Proposition

As mentioned above, at first the flexo label market benefited from digital's offering better short run process economics, but the truth is that it is no longer the main value proposition within an analog market where there is plenty of capacity and very good short run economics on the latest flexo systems.

Digital Uniqueness Generates New Applications, Users and Links Directly to Brand Owners

In the label market there is a lot of scope for enhanced products and versioning, which is the early form of variable data printing. Vendors have also done a lot of effective work with large resources to increase the awareness among brand owners about the new opportunities in the digital label market.

Barriers to the North American Market in Labels

Competitive Imbalance among Suppliers

While it's not a real barrier to market development, there is a considerable number of vendors, especially in UV Inkjet, whose systems are qualified for the market, but whose resources to reach the market and convince it of parity of performance against market leaders seem to be limited. This makes the market perhaps less competitive than it might be. This has had a knock-on effect on some parts of the market in generating an impression that UV Inkjet is not a fully comparable technology to EP.

Access to Brand Owners

As in many production digital markets, digital's value proposition often depends on selling a process advantage that rests on a print technology that is, unit-for-unit of output more expensive than analog. That is not a problem if it is possible to communicate the value proposition to the brand owner, but many vendors do not have the resources to go to brand owners directly and rely on label converters to carry the message. Converters are often more cost-oriented than value-oriented, and that is a slowing factor in the development of the digital market.

Projected New Opportunities

Narrow Format Flexible Packaging

A by-product of the labels market is the presence in the market of a lot of proven production narrow web UV Inkjet and EP presses. Inside the label market these presses are already used for printing film wraps. There are however indications that inside the mainstream flexible packaging industry there is a latent desire for expanded narrow web capability to handle short runs. This may become a new market in its own right.

Major Takeaways

Acquisition is driven by consistent demand, but the process is extended and complex, involving vendors in close co-development. This is where market fragmentation and specialization place a high burden on vendors. This is also influenced by relatively high acquisition costs among interviewees in this sector. Although ROI is often uncertain, it's accepted as such with underlying confidence in the value of investment supported by a consistent history in the market. Early market implementation is mostly successful and timely, indicating latent demand. Pure digital market development is a slower process and veers quickly to development of new markets and customers with its shallower development curve. But the new hybrid market may start to leverage significantly higher volumes taken from analog based on improved process economics and product enhancement capability.

DIRECT-TO-SHAPE

Market Analysis

Direct-to-shape (DTS) means the post-manufacture printing of 3D products. It can be in line with manufacturing or offline. It can also be low-scale, with manual loading of objects for printing at a rate of a couple per minute, or automated at more than one object per second. In digital printing of objects, there is finally a distinction between systems that can print true 3D objects and systems which use a deep flatbed platen to print flat manufactured products with some capability to print over beveled edges. This kind of printing is carried out digitally almost exclusively by UV-cure ink systems because of the need to achieve high durability and to avoid the complexity of drying 3D printed objects.

Most manufactured objects are marked in some way with a logo or information. The DTS market in digital is the stepchild of what in the analog world may be referred to as the permanent product marking market. That can range from the high-speed printing of cans and certain types of bottles (around 2,000 cans per minute using dry offset or waterless litho or pad and screen printing of motifs on 3D products at around say 20 items per minute). This is sometimes done in-house towards the end of the manufacturing line, sometimes by local semi-captive printers/decorators, and sometimes by large captive decorator companies which are vertically-specialized, as for the automotive industry.

The digital market is at an early stage of development where the most successful products are the simpler and lower-cost flatbed deep platen printers, many of which come from Japan and serve the promotional goods market.

There is also an emerging low- to mid-industrial-scale market for cylindrical object printing of bottles, cans and cups. This has a low-scale low end focused on the promotional goods market and a high end industrial market, especially supported by European vendors, that targets consumer product sectors such as craft brewing, where short runs are called for but not easily available and is in the early stages of proving its suitability to manufacturing integration.

This higher-end market is also split between volume-economics' high-speed decoration utilizing dry offset, waterless litho and some screen, and lower aggregate volume, but higher value, decoration utilizing automated screen (premium quality) printing systems at high speeds, as much as 12,000 objects per hour in some cases. (Note: An output measure in square meters is meaningless for DTS markets, so we use printed units/objects as our measure of output.) There is some early activity in the high-volume area in developing high-speed digital systems with specialized suppliers. Among the high-end, screen systems are now being offered with digital as a modular component in a hybrid format and capable of very high speeds.

Some market participants say DTS is an environmentally-friendly waste-avoiding substitute for labels that goes beyond just providing short runs in existing DTS analog markets. That is an ambitious vision not yet realized or proven to be viable. The snapshot of the current digital-analog situation in the DTS is presented in Table 10.

Table 10: North American DTS Market Positioning

Years of digital market presence in North America: 10

Directness of competition of digital to analog		
Better digital economics at low scale = directly competitive to analog	Uniqueness of digital offering	
Presence in Existing Analog Channel		
Digital integrated to Analog Channel		Separate Parallel Digital Channel
Maximum Productive Scale vs. Analog Average		
<1,000 Units/Hour Digital	20,000 Units/Hour Screen/Pad/Offs	
Digital Market Size: North America vs. EU		
North America	EU	

Source: IT Strategies

Note: these estimates are weighted to existing stand-alone low-end flatbed deep platen systems which constitute 90% or more of the existing market. High-end custom systems are just entering the market, mostly in EU.

The DTS market is so new that not everyone agrees how to define it. At its most basic it is the digital printing of 3D semi- or fully-manufactured consumer products. The idea is to be able to bring process color and full digital process control to product marking as far towards the end of the manufacturing or packaging filling line as possible, thus permitting full-quality print on demand without interfering with the economics or flow of a manufacturing line. Such custom marking would attract enhanced product sales and loyalty.

This is a recent deployment and configuration of digital inkjet technology and has first found a footing in relatively low-cost systems ($30,000–$60,000) with a flatbed format with a deep platen accommodating manually-loaded flat but 3D objects for print with UV Inkjet. That is most of today's market, which now includes semi-automated systems from newer vendors costing up to the $250,000 mark. These systems mostly print promotional give-away items, or in some cases customized high-value objects for high-value sale like metal bottles, awards or beverage containers. That market sells low thousands of systems globally each year and has a global value of around $500 million in vendor revenues for systems and inks (approximately $150 million in North America).

The market for more highly-integrated and customized production systems is smaller, though the potential is large for printing craft brewery beer cans say, whose run lengths generally exclude them from standard analog can-printing technology, or for printing promotional items on a much larger scale. This market is served by a relative handful of specialist vendors, many of whom are in Europe and have a legacy investment in production screen and pad print technology. There are also integrators specialized in custom work at this level. Most of the work in this area is exploratory; in Europe commercial high-end systems sell in the low tens now, and the number in North America may be not far above zero.

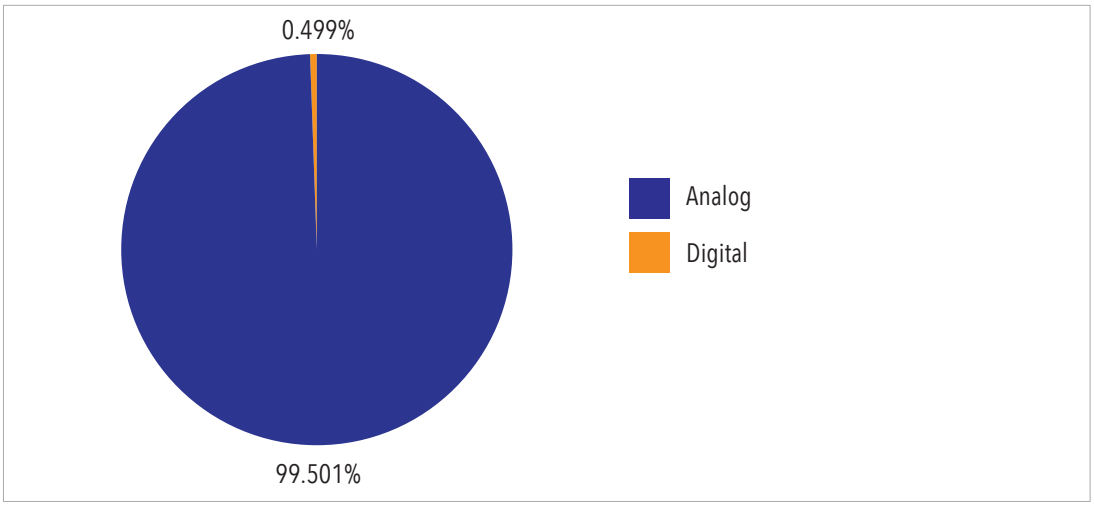
DTS digital usually replaces or supplements screen or pad printing, which are widespread technologies among captive product decorators or in-house at manufacturers. This takes place in roughly equal measure through existing printers or via external parallel-channel converters new to the market. The argument for digital is faster response and lower costs in small quantities (say up to 5,000 for promotional items or up to 100,000 for cans) and direct process color in place of monocolor or even labels.

Market Status

We will not try to set DTS against the totality of all label printing or all product marking; it is not generally seen as a mainstream technology. It is more useful to set DTS against markets it is beginning to approach, and which are seen as rational targets today: the promotional goods market, the disposable cups market, the high-end container screen print market and the craft beer market (Tables 11 and 12). For simplicity's sake, this omits mainstream industrial glass and plastic bottles and containers and all other product marking markets. All of these could, however, become viable targets in the future. Note that these markets are defined differentially by their sub-sectors.

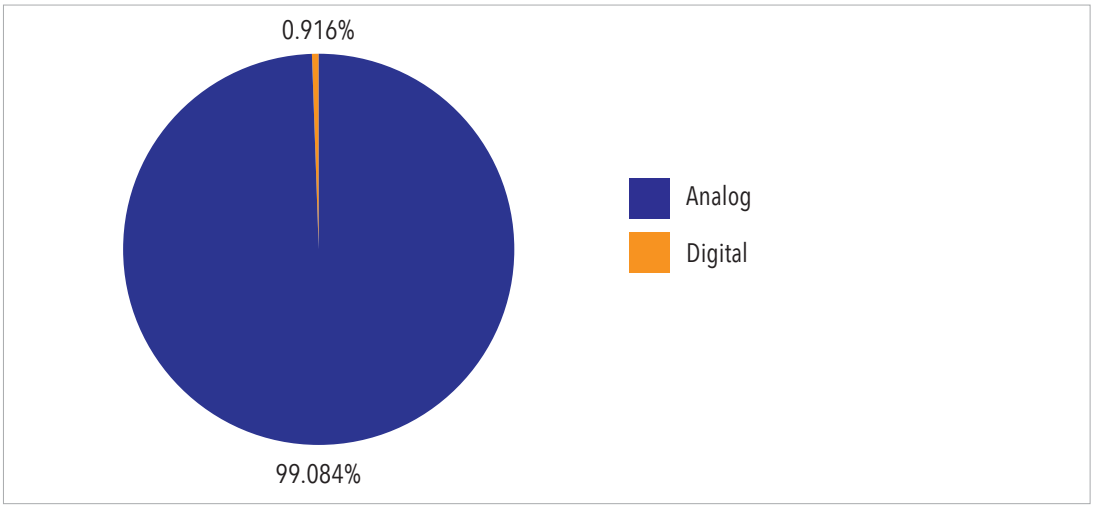
Our macro estimates are a view of the market intended to show macro relationships, but subject to more exact measurement by sub-sector. This distribution model with usable accuracy in its share estimates more than a highly accurate measurement of digital opportunity. It is, for example, not fair to suggest the total markets represent full availability to DTS, at least at this time. The intent here is only to scale object markets to current digital markets (Figures 10 and 11). The digital market (units printed) is growing at around 15% (Table 13), and the ratio of digital-to-analog output is growing even more so for the ratio of digital-to-analog revenues (Figure 12).

Figure 10: North American DTS Market: Analog vs. Digital, Units Printed (Est. 2017)



Source: IT Strategies

Figure 11: North American DTS Market: Analog vs. Digital, Revenues (Est. 2017)



Source: IT Strategies

Table 11: North American DTS Market by Product Type, Units Printed

Estimated 2017 DTS Units Printed, B (North America)		DTS Units Printed, B	DTS Units Digitally Printed, B
Promotional Goods	53.02%	220.0529	1.751715
Disposable Cups	42.18%	175.042	0.26145
Craft Beer Cans/Bottles	1.90%	7.902015	0.000415
High Value Screen-Printed Containers	2.89%	12.00305	0.05976
TOTAL		415	2.073
		100%	0.499%

Source: IT Strategies

Table 12: North American DTS Market by Product Type, Revenues

Est. DTS Revenues, $B (North America)		Revenues, $B	Revenues for Digitally Printed Products, $B
Promotional Goods	25.09%	21.075	0.369
Disposable Cups	5.02%	4.215	0.014
Craft Beer Cans/Bottles	28.08%	23.584	0.003
High Value Screen-Printed Containers	41.82%	35.125	0.384
TOTAL		84	0.770
		100%	0.92%

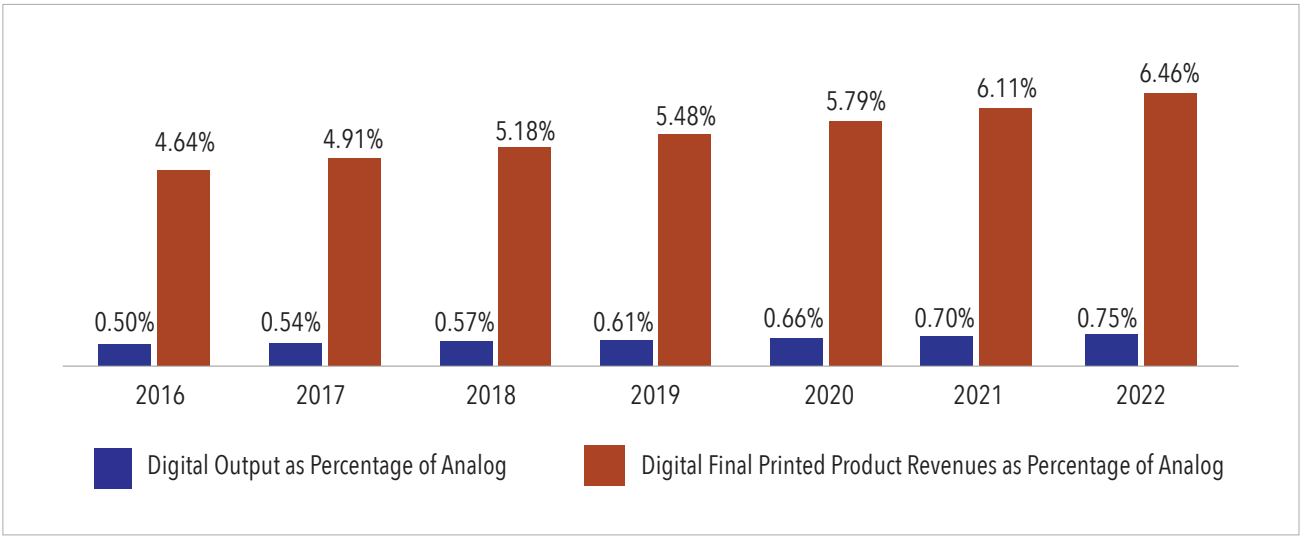
Source: IT Strategies

Table 13: DTS – Analog vs. Digital, Output and Revenues, Forecast (North America)

	2016	2017	2018	2019	2020	2021	2022	CAGR
Analog Units Printed, B Units	414.40	445.48	478.89	514.81	553.42	594.92	639.54	7.50%
Digital Units Printed, B Units	2.08	2.39	2.75	3.16	3.64	4.18	4.81	15.00%
Analog Printed Product Revenues, $B	84.00	89.04	94.38	100.05	106.05	112.41	119.16	6.00%
Digital Printed Product Revenues, $B	3.90	4.37	4.89	5.48	6.14	6.87	7.70	12.00%

Source: IT Strategies

Figure 12: DTS - Digital Output and Revenues as Percentage of Analog, Forecast (North America)



Source: IT Strategies

Digital Technology Formats, Scale and 5-Year Targets

Especially in North America, today's DTS market is mostly made up of what we call flatbed deep platen UV Inkjet systems (more or less automated), priced roughly from $30,000 to $200,000 and with some capabilities in printing non-flat surfaces at the higher end. Thus, it is mostly a "low-end" market so far. There are vendors (mostly, but not exclusively) in Europe of more highly integrated systems designed to ultimately move in line with packaging filler or manufacturing lines. These have had some early success in Europe, and there are some custom projects in production systems going on behind closed doors in North America and Europe.

Digital Value Proposition

At the low end of the market, the argument for personalizing promotional items, event-related items, awards etc. is obvious, and the market is absorbing the technology quite enthusiastically. At the high end, there are arguments given for replacing labels and saving the environment, which are arguably missing the point of what a label does. Perhaps the best arguments are, once again, around economic costs of short runs. A craft brewer with beer edition run lengths under 100,000 cannot economically easily use current offset and screen can printing methods to identify and sell his product, so he will use a label or a wrap. This would arguably be better and more simply done with DTS systems economic at those run lengths. The same argument could be made in specialist parts of the very large beverage container industry (including cups). Additionally, digital can generate a process color image in some areas where pad and screen cannot.

Analog/Digital Channel Overlap

At this time the substantial market in flatbed deep platen systems is focused on more or less specialized independent print service providers (PSPs) who offer promotional and event-related printed items. Some of these companies are product decorators already using screen and pad printing technology, and to that extent digital is going into an existing channel, but some are not. Larger-scale adoption within an existing channel would involve adoption by larger semi-captive vertical-specific product decorators but also by packaging/filling machinery vertical suppliers and their customers, product manufacturers or fillers. There are some custom projects occurring at that level, but they do not seem to be common yet. This is partly the case in North America because some of the earlier vendors/integrators of larger systems are European but without necessarily having the resources to be in North America at this time.

Analog Vendors' Market Participation in Digital Market

At the low end, some of the vendors are from the digital world, though there are also very good customizing vendors from the pad and screen-printing world. At the high end, among the European vendors the majority of companies come from product marking in screen and other technology areas and are coming at the market from the quadrant of the existing market. Often they are higher-end specialists since a lot of low end product marking with analog technology is done in-house or by local vertical semi-captive product decorators without the need for system suppliers per se.

Positioning of Analog and Digital Print Today in DTS Markets

In the market sectors we focus on as offering realistic DTS potential, digital products are positioned at an entry level as flatbed deep-platen printers available from four to five manufacturers at costs around $40,000–$50,000. These printers are successful and are sold to the promotional products market for product personalization around events. Customers are sometimes promotional goods manufacturers or distributors and sometimes general PSPs expanding their event graphics coverage capability. This market also includes manufacturers and brand owners who, on a small scale, wish to customize products in-house or through a contractor-decorator (e.g., a toothpaste manufacturer printing customized brushes and tubes for dentists). This is the largest DTS market and has come to include second-tier products, which can go beyond flatbed printing to semi-automated flatbed printing and can also print cylindrical or conical shapes. Several Japanese and US vendors are to be found in this sector. In the lowest tier, systems are very slow at perhaps 100–200 items per hour, while the second -tier types of products, which are semi-automated, can get up to speeds closer to 1,000–2,000/h and cost around the $200,000 mark.

Above that level, there are low end industrial DTS systems costing from $50,000 up to $200,000, designed from scratch to print 3D objects. At this level the systems are often relatively slow (up to low hundreds of units per hour) and often deploy manual loading. This is an incipient development and barely a market in North America, but there are a few companies who up-develop them to a higher level of automation for wider sale or for their own use. One issue is therefore the durability and capability of integration of this sector. These types of systems are available from a handful of European and US companies but so far in very small numbers.

At the next level, more or less off-the-shelf but customizable, fully industrialized, auto-feed DTS systems are available at much higher speeds sometimes getting up around a claimed 12,000 units per hour for prices ranging from the mid-hundred thousands to around $2 million. These systems are also at a very early stage of development and have hardly been sold in North America at all. European vendors are found in this sector, and indeed the European market seems to be a little ahead of North America, but not by much. These kinds of systems tend to be sold so far in very small quantities into the high-end specialized automated screen-printing markets where analog systems sales globally are probably in the very low hundreds. In this sector digital systems are sometimes sold as stand-alone and sometimes as hybrid systems within screen systems. This market was euphoric for a couple of years but is now settling into a slower reality, but with much potential market to develop all the same.

Finally, there are custom in-house developments of high-end systems typically by specialized machinery manufacturers with deep positionings in markets such as the beverage industry. This is an experimental area so far. There is little commercialization of large sale systems and a lot of secrecy around individual companies' work.

Competitive Conditions in the North American DTS Market

Flatbed deep platen systems are sold by Japanese and US vendors. They have also typically successfully developed versions of these systems to be capable of cylindrical and conical print and sometimes they act as co-developers of customized systems. This part of the market is young, but quite well developed with thousands of installed systems in North America

A series of mid-range and high-end 3D product printing systems tend to be developed by European vendors, some of them with a strong pre-existing supply position in 3D analog automated printing systems and conversion systems feeding into specialist parts of the packaging industries. Sales of legacy non-digital products have been to specialist packaging print providers who in turn will sell the printed product on to the manufacturer/filler. Sometimes the sale can also be to a decorator company providing marking for partially manufactured parts such as for the automotive industry. This part of the market has hardly started in North America in terms of vendor presence, integration capability, proof in the market and proof of a sufficient value proposition. The value proposition issue partly relates to the notorious old issue of being able to persuade the PSP customer/brand owner of the real presence and capability of the new technology, and its potential effects on the larger industry offering to final consumers.

DTS Channels

DTS systems as we define them cover a wide range of specifications. The flatbed deep platen systems and the lower-end 3D shape printers (sub-$200,000) can be sold to PSPs. The PSPs may be general graphics/events-oriented promo/graphics suppliers focused on promotional goods for specific major users or user groups or vertically-oriented, perhaps the plastics container industry, but still an independent shop. The required skills of these types of environments vary. Some just use the system out of the box within its existing specs, while others will significantly integrate the existing systems upwards to automation and become, as a result, active systems developers in their own right (sometimes with exclusive rights). Promotional goods suppliers generally already are screen printers who benefit from digital's ability to print products within much shorter time cycles than screen.

When you move up to the next level, systems over $200,000 are targeted at decorators who are usually oriented to vertical industries or specific product types (such as high-value cans or industrial containers). Those decorators targeted for DTS digital at this time tend to be the high-value screen-printers who already serve a specialist high value analog market. There is some interest here too on the part of goods manufacturers and taking DTS systems in line with filling at the product factory. But whether factories want to be involved in print in the long run is an open question. These kinds of systems are targeted at high volume applications in the high thousands of objects printed per hour. The activities surrounding manufacturer systems development are naturally relatively secretive.

Primary Research Analysis: Interview Targets within DTS Environments

We targeted low end flatbed deep platen users as representative of the most successful part of the DTS market to date. We also targeted some users of low- to mid-end cylindrical and conical object systems derived from lower-end system architecture. We further included some high-end systems users with fast, automated systems printing bottle/can-type products. We were almost unable to interview any of the few developers of customized high-end systems intended for potential factory/filling-integration as such projects tend to be considered entirely confidential.

Table 14: Summary of DTS Market Interviewees

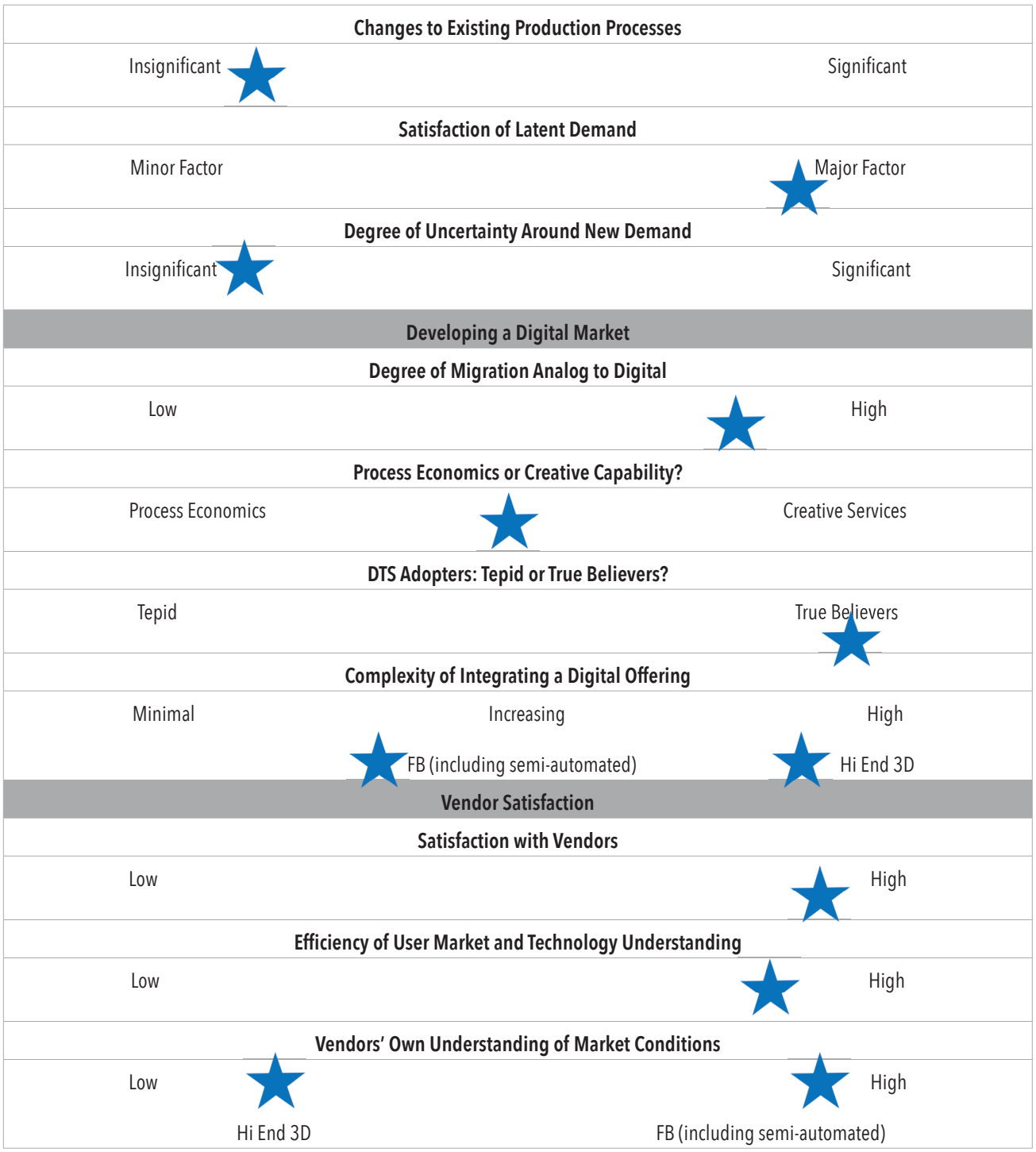
#1 Promotional Goods Manufacturer. Printing Bottles Western US		
Estimated revenues $10 million	7 years in Digital	Multiple stand-alone cylinder systems custom-automated
#2 Small Specialist Vertical Promotional Goods Supplier/Printer Northeast US		
Estimated revenues $7+ million	5 years in Digital	Multiple FB DP semi-automated stand-alone systems + screen print
#3 Mid-sized Vacuum-Molded High Value Plastic Cylinders Supplier/Decorator Western US		
Estimated revenues $11 million	2 years in Digital	HE Automated hybrid Inkjet + screen print
#4 Major Employee Rewards and Recognition Company		
Estimated revenues $380 million	5 years in Digital	Multiple Stand-alone FB DP systems + Indigos
#5 Mid-sized Promo Goods Supplier		
Estimated revenues $10 million	5 years in Digital	Multiple stand-alone FB DP systems + screen print
#6 Major Container Processing Systems Vendor		
Estimated revenues $250+ million	Experimental	Production can printing system project
#7 Mid-sized Product Decorator		
Estimated revenues $40 million	1 year in Digital	Mid-range semi-automated digital system

Digital Acquisition

To better understand the development of digital print technology in the DTS market, we analyzed the adoption process of digital: its length, sources of information, changes to the existing process, ROI expectations and vendor satisfaction (Table 15).

Table 15: DTS Digital Acquisition – Research Schematic Summary

DTS Digital Acquisition – Research Schematic Summary			
Technology Acquisition			
Sales Cycle to Acquisition			
6 months ★	1 year	2 years	3 years
Due Diligence Format			
Publications	Trade Shows ★	Peers	Vendor Commitment ★
	FB (including semi-automated)		Hi End 3D
Financing Mode			
Cash ★		Self Finance	Bank Finance
Amortization Period			
1 Year	2 Years	5 Years ★	10 Years
ROI			
Accuracy of Model			
Poor	★		Comprehensive
Missing Inputs with Hindsight			
0%	★		100%
Degree of Continuing Confidence in Investment			
0%			100% ★
ROI Achievement Period			
1 Year	2 Years ★	5 Years	10 Years
Early Market Development			
Net Process Cost Increase Because of Digital			
Reduction ★	Neutral	Some Increase	Large Increase



Technology Acquisition

At the low end, with slow stand-alone and enhanced flatbed-architecture semi-automated systems, there is vibrant North American demand broadly around the promotional industry, which vendors satisfy well with much growth yet available. The mix of stand-alone and semi-automated systems at significantly variable performance and price levels from multiple vendors is appropriate and competitive. For true 3D object printers there is a small market for sub-$200K systems, but they are often in need of enhanced development. At the very high end, whether for available EU-origin systems or for integration development, there is almost no North American market yet.

ROI

Where there is an established market around the flatbed-architecture types of systems, with or without enhanced automation, the case for digital against screen in the promotional goods industry is taken as a given. That fact added to the relatively low-cost of systems ($30,000 to $200,000) means that relatively little attention is given to ROI as a formal calculation; in any case, the experience has been one of enhanced flexibility, lowered costs and expanded opportunity. In the higher sectors there is not enough of a market to be able to speak of an experience of ROI yet, though the case for digital is more or less assumed to be positive.

Early Market Development

The market that has developed around the flatbed-architecture low- to mid-sized systems developed well with simple slow systems at first, but within a short time the need for semi-automation showed itself, giving rise to opportunity for US-based vendors who developed these enhancements on the back of existing systems. As a result the volumes of print are beng increasingly generated by the higher-specified systems. Those systems cost much more, but quickly pay for themseves in the appropriate economic environments. There is really is no true market development beyond these levels.

Developing a Digital Market

At high and low end of the direct object printing market there is a shared assumption that existing imaging/printing methods are inadequate in terms of quality as well as at the kind of short runs that customization will require. And customization is the future for the high end of manufactured objects whether for promotional purposes or involving high-end beverages and cosmetics. No one questions the future value and importance of digital technology in developing future larger markets. So why is there such a relatively small development in systems so far beyond the low end? It's partly that high-end systems are complex, and product manufacturers and inkjet integrators need to cooperate and share knowledge on the development, but our interviewees also said that printers, decorators, legacy machinery manufacturers and converters are not taking enough initiative in adopting the new technology in North America.

Vendor Satisfaction

So far there is satisfaction with vendors within the limits of what they do in the existing markets and activities in North America. At the low end, where the largest market is, there is specific satisfaction with the ability of local vendors to quickly develop enhanced systems. But within the context of overall market potential for DTS, the experience to date has been limited. From an observer's perspective, the offerings of the DTS vendors above the flatbed-architecture level globally is from legacy manufacturers with relatively limited resources. Greater resources will yet be required to spark an industrial-level takeoff for DTS.

Current Status of Digital Production Print in Industrial Markets

Level of Development

Technology suitable for strategic insertion into the DTS market is available only in simplified formats (like deep plate flatbed), or else in still-experimental forms sometimes under development by individual users or industries. There is some free-market technology available in true 3+ axis print format in mid-to-upper level integration to manufacturing, but it is mostly in Europe, and even there is mostly at a test stage.

Digital Market Relationship to Analog

There is a strong, but still somewhat theoretical, argument for short-run digital capability as a direct complement to analog DTS offset, screen and pad print offerings. A good example is in craft brewing, which is a very large industry with average run lengths that do not reach minimum high-volume analog DTS thresholds. But caution is advised. The craft brewing industry has become huge without digital DTS to date. By contrast, some of the early DTS markets are for novelty products that are substantially independent as markets from the constraints of analog high-volume systems. This true 3+ axis production market at a higher volume industrial level probably requires a substantial deepening of involvement of analog marking equipment suppliers (who have a deep understanding of this complex 3D imaging engineering among verticals) as well as a wider base of better-capitalized equipment developers. This need for development by vertical insiders along with a need for an independent supplier base is hard to reconcile, so that this market is likely to see relatively slow development at the volume end.

Satisfaction of Users

Novelty and marketing specialty users at the low end using flatbed deep platen systems are very happy with the technology and are quickly building the market to over $500 billion. But at the high end by vertical there is far too little penetration to be able to speak of experience, let alone satisfaction, yet.

Economics and Functionality at the Very Low End is the Initial Value Proposition

There does appear to be a substantial economic argument for DTS of the 3+ axis variety where short run is very hard to accomplish with analog technology. And at the low end the argument is for a new localized customized product otherwise not available and so represents essentially a new market. But as stated above, the high-end market seems to handle short runs of at least some important physical products without apparent access to short run print technologies – at least simple ones.

Digital Uniqueness Brings New Apps, Users and Links Directly to Brand Owners

The low-end DTS market for flatbed deep platen systems are pure markets for customization or new products in value terms. Speaking of the market potential, at the high end and in volume, the argument for really new products enabled by digital print is not yet clear, because the short run problem hasn't even been effectively answered yet. It is imaginable, but not seen as a driver at this time, at the higher end. Indeed, some of the earliest vertical high-end DTS developers have apparently put the technology forward in some cases not to address volume so much but to provide occasional (non-strategic) customization.

Barriers to the North American Market in DTS

Complexity of Upper DTS Access

The means of accessing industrial scale DTS markets and allowing for innovative, differentiated integration and customization for industry sub-sectors are only partially available through larger screen printing decorators, and are arguably an overly cost-driven barrier to reaching product manufacturers where DTS systems may be best positioned in future.

Lack of Local Integration Resources

The upper DTS market also needs strong, well-resourced and expert inkjet integrators/vendors. These appear to be more easily found in Europe than in the US.

Immaturity of Digital Print Technologies

Digital inkjet printing technologies, whether aqueous, solvent or UV, are still at a relatively early stage of development, while EP technology is more mature but has throughput and complexity limits rendering it inapplicable to many industrial markets. Inkjet's development issues relate to large-scale integration in single-pass format, economics of high volume print, ink/substrate compatibility and lack of a higher-scale infrastructure of general inkjet engine integration skills. Inkjet may therefore be expected to reach much more advanced levels of economic and physical performance in future. This is most especially true for DTS markets where the complexities of in-line 3D object manufacturing must be accommodated.

Low Scale of Channels and Technology Slows Rate of Share Development and Economic Down-Scaling of Costs

As digital markets first establish themselves, there is a tendency to sell lower-scale systems and to focus on their development in markets to the exclusion of production systems. This is not wrong in itself, it is just sometimes a choice made, and can result in resources being diverted to the low end. This is also motivated by the higher margins that tend to be available in lower-scaled systems against the pressure on costs that come with production systems, especially in markets with a low-cost analog production model as the frame of reference. Flatbed deep platen systems may be an example of this in DTS.

Projected New Opportunities

DTS Hi-End Integration

DTS holds the potential to be a major player in high-end customized formats suited to industries like beverage filling, entertainment industry-driven merchandizing and high-end product customization. While there may be initiatives underway not visible to researchers, it seems as if there's not enough work taking place at this level in North America in comparison to Europe and in relation to the current capability of UV Inkjet systems and technology. The value proposition here is mostly process cost improvement in support of a diversifying end-user customer base.

Major Takeaways

The biggest driver of DTS is the promotional goods market, where simple printing of mostly flat objects offers an immediate and clear process time/cost advantage over existing screen printing customization. The market tends to be local, small-scale, and suited to relatively low-cost systems and is growing well with the current offerings. A sub-sector in promotional markets has also grown well in the US driven by US vendors for semi-automated systems with significantly higher productivity. This sector is also satisfied with its offerings. High-end highly productive hybrid (analog and digital) and customized systems are still sold in very modest numbers, if at all, and are directed mostly at high value specialist packaging sectors through specialist decorators and machinery suppliers. This part of the market is still to be developed.

Conclusion

Decorative

Decorative markets in the US are historically almost undeveloped compared to Europe, and the future digital markets are very much under the influence of today's integrated analog providers. The balance of opinion, however, is that US consumers are as susceptible to new surface and print technology variability as anyone and that there is much latent demand to be leveraged.

Major decorative surface suppliers will soon have access to variably-scaled digital print alternatives early-developed in Europe. A diversely-printed future decorative market is an opportunity at its earliest stages awaiting entrepreneurial offerings in the next 5 years based on dedicated digital print technology.

Production Labels

Digital production label printing systems have been well established in the mainstream analog US converter market for over 20 years and have developed into specialized high-value markets of strategic importance to converters. At this time, more highly-integrated hybrid analog/digital systems are taking the market to the next scale level while scaled-down, lower-cost systems are making digital available to most smaller converters. This market is entering the accelerated growth segment of the market curve.

Digital has had 20 years in the label market to develop the concept of product specialization and value-add based on variable content within a conservative analog community. They have passed the concept on to users. Users are now increasing their demand for high-value, low-volume labels from their established label converters and the other PSPs they use. Digital labels are becoming an equal-opportunity item for more than just dedicated label converters.

Direct-to-Shape

The digital direct-to-shape market in the US is almost undeveloped at the high end (e.g., for canning and bottling plants), and in the promotional market for cylindrical micro-run prints an as-yet uncertain start has been made. Only the 2D-type finished good deep-platen systems market has developed fully into a market (also a part of the promotional market).

The value proposition for digitally printing of manufactured objects is strong, allowing personalization and otherwise-unavailable short runs of printed products. The value is in personalization of products and short runs, not in label replacement. But the technology beyond 2D surfaces is not fully ready. Europe is ahead of the US in the direct-to-shape market, but not by much. Close selective testing of new equipment is advisable, as is readiness to take control, once technology is available, of a very large potential US market.

WHO WE ARE

IT Strategies, Inc.

Founded in 1992 by Mark Hanley, IT Strategies is a strategic consultancy specializing in industrial digital printing, inkjet technology and early market development practices. The company is based in Boston and Tokyo and operates on a private partnership basis. IT Strategies is a confidential practice with no publishing function and is expert in technology and market analysis based on a wide factual knowledge base.

www.it-strategies.com
51 Mill Street, Suite 2, Hanover, MA 02339
781.826.0200

SGIA — Supporting the Leaders of the Digital & Screen Printing Community

Specialty Graphic Imaging Association (SGIA) is the trade association of choice for professionals in the industrial, graphic, garment, textile, electronics, packaging and commercial printing communities looking to grow their business into new market segments through the incorporation of the latest printing technologies. SGIA membership comprises these diverse segments, all of which are moving rapidly towards digital adoption. As long-time champions of digital technologies and techniques, SGIA is the community of peers you are looking for to help navigate the challenges of this process. Additionally, the SGIA Expo is the largest trade show for print technology in North America. "Whatever the medium, whatever the message, print is indispensable. Join the community – SGIA."

For more information on SGIA, visit SGIA.org.