PDF/X-4 Today and for Tomorrow

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Abstract

The PDF/X-4 format is now just over five years old – it was initially published as an ISO standard, under ISO15930–7, in 2010. At that time, it was a significant update to the original PDF/X-1 ISO standard (15930–1) because it was based on an updated version of the Adobe Portable Document Format (PDF) Library, v1.6, and therefore supported a richer feature set. These features include native support of transparency in artwork, ICC-based color management, optional content (layers), as well as support for 16 bit image workflows. This paper seeks to determine the relative support and 'uptake' of the file format in printing and publishing workflows today.

Originally developed to meet the requirements of the publishing industry for digital advertising materials, PDF/X-1 was designed to be a file format capable of achieving the predictability and quality of analog film content carriers. Configured to be exchanged 'blindly' between parties, it was envisioned that content creators and file receivers would not need to discuss file formats, software versions, and final printing conditions, or to make support art and fonts available separately, prior to outputting the file. This accurate and predictable method of digitally exchanging print based final files also offered benefits for other graphic workflows, including commercial, catalog, and flyer.

Generally considered to be a success for the publishing and printing industries, PDF/X-1-a continues to be incorporated today into page layout applications, preflight tools, as well as numerous publishing 'ad portals' (used for the successful delivery of magazine ad materials).

Also important for PDF/X-4 in 2010, print based workflow systems were seeing the shift from those that were primarily built around Adobe's Configurable PostScript Interpreter (CPSI), towards 'native' PDF renderers. These workflows do not convert content to PostScript, with the subsequent flattening issues.

Ryerson University

At the time PostScript, a Page Description Language (PDL) developed by Adobe in the mid 1980's, had evolved into the leading imaging model used to render graphics in printing and publishing. Ostensibly device independent, in practice PostScript files were generally created for specific workflows and output devices, one limitation as a blind exchange format. As well, the PostScript imaging model is opaque, and therefore any transparent objects, such as drop shadows, must be flattened before final output.

This flattening of art can lead to numerous reproduction issues, including incorrect colorspace conversions, incorrect output resolution, and concerns about artifacts in final output. As well, flattening also impacts late stage edits, and the ability to effectively repurpose the final PDF files (text which has been flattened can't easily be extracted or searched on).

Global Graphics had supported native PDF workflows since 2002, with their 'Eclipse Release' of their popular Harlequin Raster Image Processor (RIP). Adobe introduced their native PDF 'Print Engine' in 2006. Understandably it can take Original Equipment Manufacturers (OEMs) time to incorporate newer technologies into their products, as well, their Clients may not immediately upgrade to the latest version, and educate their staff on the new capabilities. Subsequently it is reasonable to anticipate that there was a delay, or lag, in the uptake of these new technologies.

This practical research paper encompasses three different aspects. The first is to configure a modern workflow system, Kodak Unified Workflow Solutions Prinergy v7, using the current version of the Adobe PDF Print Engine, in a controlled environment and verify the relative support for PDF/X-4 files. This was initially accomplished using the current version (v4) of the Ghent Workgroup Output Suite (GWG 2015).

The second aspect involved the creation of a simulated (mock-up) consumer package good (CPG) file, using Adobe InDesign Creative Suite v6, to export as a benchmark 'real world' PDF/X-4 file. The design uses a combination of color spaces, transparency-blending modes, and relevant optional content layers. It is used to further demonstrate and verify processing through the configured workflow system.

The third part of the paper discusses perspectives on the relative uptake of the PDF/X-4 format in common industry workflows. Interviews and discussions with industry practitioners, as well as preliminary survey results from a Magazines Canada survey concerning X-4, are used to create a snapshot picture of the use of PDF/X-4 files in the North American commercial, packaging and publishing sectors.

These discussions seek to identify and clarify if and how PDF/X-4 is being used to leverage the benefits initially proposed; how it addresses transparency flattening issues and any related reproduction concerns and color managed RGB workflows. As well it identifies opportunities where final X-4 files are being used as the 'record of truth', and being leveraged for cross media workflows. In addition it explores the adoption and use of optional content layers in X-4 files in workflows.

For example, in the publishing industry, the Idealliance's Specification for Web Offset Publications (SWOP) Working Group recently formed an initiative to encourage the adoption of PDF/X-4 in the advertising and publishing industries. Referred to as PDF/X+ ('plus') format, it uses PDF/X-4 as a base, however with caveats that the file needs to use CMYK image data, and that it cannot include optional content layers. Effectively it gives the benefits of native transparency, without the downstream responsibility of RGB conversions, or the possible confusion of layered content.

Alternatively, the Ghent Workgroup is also working on an initiative to foster the further use of the PDF/X-4 specification, in this case for packaging industries. This addition to the specification would need to address packaging specific issues, which include non-CMYK colors (spots, white ink, double 'hits' of colorant…). As well it seeks to develop a common mechanism (naming and use convention) for identifying content, and assigning it to specified layers. This would be necessary to automate successfully sharing, and acting on, layered content by PDF readers throughout the workflow.

This paper is important for different areas of the graphic communications industry. It offers guidelines and recommendations for the successful use of PDF/X-4; as well it identifies and discusses aspects of the PDF/X-4 specification that may need further refinement and clarification in order to increase adoption of the format.

Background – PDF/X-1a

In general, periodical publishers and their advertisers were some of the last areas of commercial and web offset workflow to migrate from conventional film based image carriers to 'computer to plate' (CtP) processes (Masthead 2000). This was due in part to the challenges – costs and liabilities – associated with accepting advertising materials in digital format.

The technical changes at the time contributed to a general culture of apprehension between advertising agencies, media buyers, film houses, publishers, and printers concerning accountability, liability and responsibility of successful reproduction of ad materials.

Originally developed to meet these requirements of the publishing industry for digital advertising materials, PDF/X-1 was designed to be a file format capable of achieving the predictability and quality of analog film content carriers.

Based on Adobe's PDF language 1.3 (Acrobat 4), it was initially developed by the American National Standards Institute (ANSI) in 1999, it was passed to the International Standards Organization (ISO) and was published in 2001 as ISO 15930-1:2001: PDF/X-1a:2001, blind exchange in CMYK + Spot Colors (ISO 2001).

Designed to be economical to economical to produce and consume, it was configured to be exchanged 'blindly' between parties, it was envisioned that content creators and file receivers would not need to discuss file formats, software versions, and final printing conditions, or to make support art and fonts available separately, prior to outputting the file.

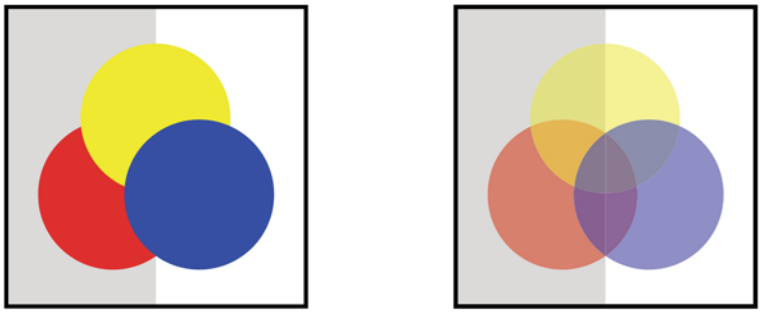
Important characteristics of a PDF/X-1a file that supported this blind exchange, included that an X-1 file could only be CMYK and / or spot colors, and that fonts must be embedded. It must also have information that the file is a PDF/X-1a, and that it has either been trapped, or not. It also needs an output intent describing the intended printing condition, – the 'CMYK' working space.

Generally considered to be a success for the publishing and printing industries, PDF/X-1a continues to be incorporated today into current page layout applications, such as Adobe's InDesign, and other 2015 Creative Cloud apps, as well as QuarkXPress 2015, preflight tools including callas pdfToolbox, Enfocus PitStop, and Markzware Flightcheck, As well as numerous publishing 'ad portals' (widely used for the successful online delivery of magazine ad materials) such as Blanchard Systems SendMyAd and Wave2 Ad Portal support PDF/X-1a files (sources: individual company websites).

This accurate and predictable method of digitally exchanging print based final files also offered benefits for other graphic workflows, including commercial, catalog, and flyer.

PDF 1.6 changes – PDF/X-4

The original imaging model of PDF was opaque, similar to the PostScript imaging model. Any transparent objects, such as drop shadows, needed to be 'flattened' before final output.



Adobe® Portable Document Format Version 1.7 (2006) Adobe Systems Incorporated

Figure 1: *Transparency Imaging Model*

This flattening of art can lead to numerous reproduction issues, including incorrect colorspace conversions, incorrect output resolution, and concerns about artifacts in final output. As well, flattening also impacts late stage edits, and the ability to effectively repurpose the final PDF files (text which has been flattened can't easily be extracted or searched on).

In 2001 Adobe released Acrobat 5 and PDF 1.4, which included an important key function, transparency (Adobe 2001). In 2003, Acrobat 6 and PDF 1.5 added another potentially valuable feature, Optional Content Groups (layers) (Adobe 2003).

Support for Native Transparency

Global Graphics developed support for native PDF workflows in 2002, with their 'Eclipse Release' of their popular Harlequin Raster Image Processor (RIP) (Global Graphics 2008). Adobe later introduced their version of a RIP for a native PDF workflow, the 'Adobe PDF Print Engine' in 2006 (Adobe n.d.).

Understandably it can take Original Equipment Manufacturers (OEMs) time to incorporate newer technologies into their products. As well, end users may not immediately upgrade to the latest versions, and provide training for their staff on new capabilities. Subsequently it is reasonable to anticipate that there can be a delay in the 'uptake' of new technologies.

PDF/X-4: 2008

Taking advantage of the new functionality in the updated PDF specification, the ISO TC 130 developed PDF/X-4: 2008 format. Based on PDF 1.6, the new standard supported the use of native transparency (files did not have to be flattened

like PDF/X-1a), as well as additional color spaces (RGB, Lab) and ICC profiles for color managed workflows. The new standard also supported the use of Optional Content Groups (OCGs) (ISO 2010).

PDF/X-4: 2010

The ISO TC 130 updated PDF/X-4 in 2010 to address some ambiguities and include support for user-modifiable layers in the PDF file (PDFX-Ready 2014).

Subsets of PDF/X-4

Other versions of PDF/X-4 also exist, PDF/X-4p supports externally referenced print characterization data.

PDF/X-5:2010 (ISO 2010b), and its variants, PDF/X-5g, PDF/X-5n, and PDF/X-5pg, are further subsets of PDF/X-4. They were developed to support use cases with externally referenced images, as well as externally referenced ICC-profiles and fonts (ISO 2010b). Referencing this information "outside of the individual main content file can allow for smaller PDF files" (Lisi-Smyth 2010). PDF/X-5n is "very specific and interesting for packaging" (Stephan Jaeggi, personal communication, February 23, 2016). Used to support 'N channel output intents', for simulating PMS colors with non-CMYK inks (these are not allowed in X-4).

Part 1 - PDF/ X-4 Today & workflow systems

Kodak Prinergy 7

The first part of this practical research paper is to configure a modern production workflow system, Kodak's Unified Workflow Solutions Prinergy v7, using the current version of the Adobe PDF Print Engine, in a controlled environment to verify the relative support for PDF/X-4 files.

Kodak was selected because of their relative success in the North American market for periodical, catalog, and commercial sheetfed and web printing (prepressure 2013).

These are markets that are generally considered to be adopters of PDF/X-1a, and possibly, along with their Clients, potential to adopt a PDF/X-4 based workflow.

Prinergy 7 (released Q2 2105) included some updates relevant for PDF/X-4, including integration of callus software's 'pdftoolbox' preflight software. Prinergy 7 also included improved support for layered PDF workflows (Kodak 2015). This update is important, and could offer "better support for more complicated publication and packaging jobs" (Zwang 2015).

Numerous other vendors offer workflow systems supporting PDF/X-4, including; AGFA Apogee Prepress, DALIM Twist, EFI Fiery, ESKO Automation Engine, Océ and others (GWG 2015b).

The Ghent Workgroup and PDF/X-4 workflows

The Ghent Workgroup (GWG) is an international organization focused on developing best practices for both publishing and packaging workflows. Members include production people, vendors and consultants (GWG n.d.).

The group develops application settings and 'preflight profiles', as well as an Output Suite with targets designed to check workflow support of different PDF/X standards (GWG 2015).

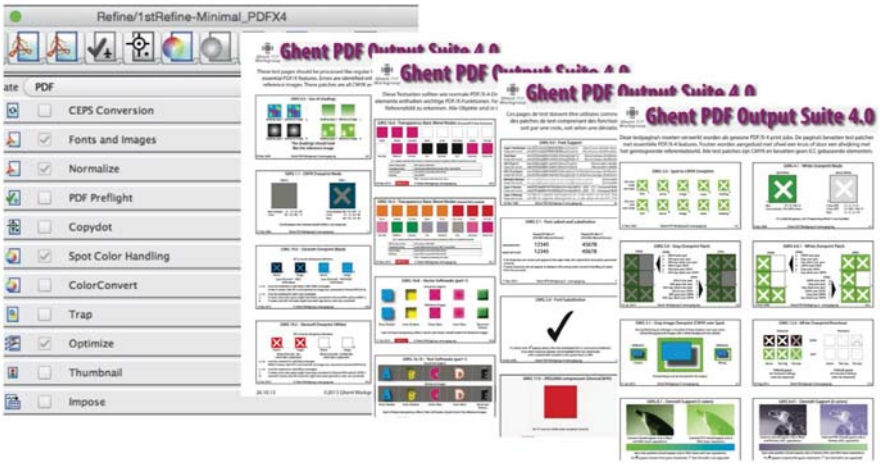
Additionally, the GWG also offers material from a variety of different vendors on how to configure workflows to support the correct processing of GWG targets, and therefore 'benchmark' support for an PDF/X-4 workflow. It is important to note that the GWG does not test or verify the instructions supplied by vendors.

In the case of Prinergy, the English language instructions were originally posted by Kodak in late 2014 by Kodak, and are available directly at (Kodak 2014).

The first part of the process requires the 'job' to be configured to process files using the Adobe PDF Print Engine. Kodak Prinergy and other systems continue to offer support for the legacy CPSI (Configurable PostScript Interpreter) workflows Kodak (2015). This is important for workflows built on PDF/X-1a, and could have implications for the adoption of PDF/X-4.

To help avoid possible mismatches between different systems for input file processing and final output there is the ability to set the process to fail.

Kodak's PDF/X-4 instructions reference a supplied set up for processing ('process plan') '1stRefine-Minimal' Kodak (2014). Production environments would reasonably need to modify a wide variety of their process plans to support a variety of different configurations for incoming files (four color process, process plus spot, different preflight requirements…).



screen capture Kodak Prinergy v7 Workshop 'Refine Process Plan' 1stRefine-Minimal_PDFX4
Ghent Workgroup PDF Output Suite 4.0 output processed through Kodak Prinergy v7

Figure 2: *Kodak base PDF/X-4 settings and Resulting Ghent Workgroup Target outputs*

The supplied process plan was applied to the GWG Output Suite v4 files, and output according to Kodak's instructions. The resulting output was evaluated with regards to knockouts and overprints, font handling, compression support, transparency, optional content, and others (GWG 2015). The results verified that the Prinergy 7 workflow was supporting PDF/X-4.

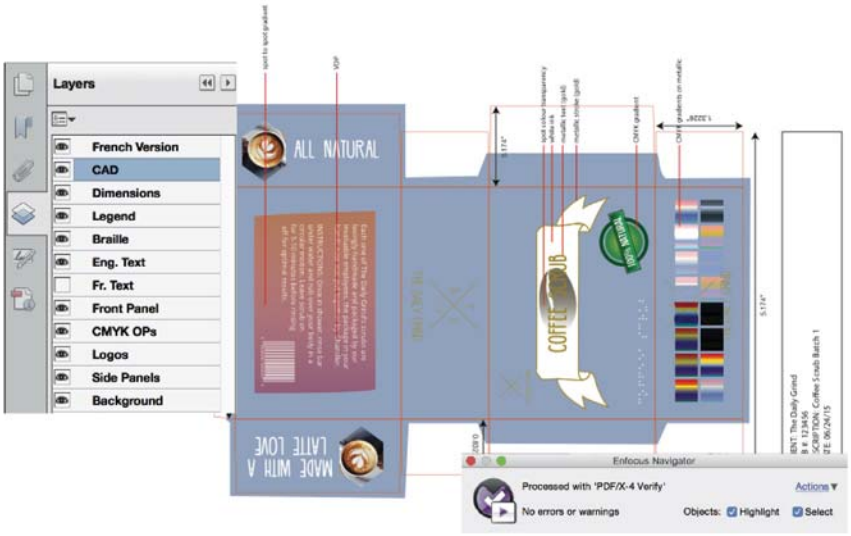
Part 2 – 'mock-up' CPG PDF/ X-4 & Optional Content

The second aspect of this research project involved the creation of a simulated (mock-up) consumer package good (CPG) file, using Adobe Illustrator Creative Suite v6, to export as a benchmark packaging PDF/X-4 file.

Alyssa Andino, a Research Assistant from the School of Graphic Communications at Ryerson University, researched common packaging workflows, and final file requirements, and designed a pseudo package, 'The Daily Grind'. The design uses a combination of color spaces and transparency-blending modes. It also utilizes relevant optional content layers, instead of spot colors, to communicate non-print mechanical information.

The file includes:

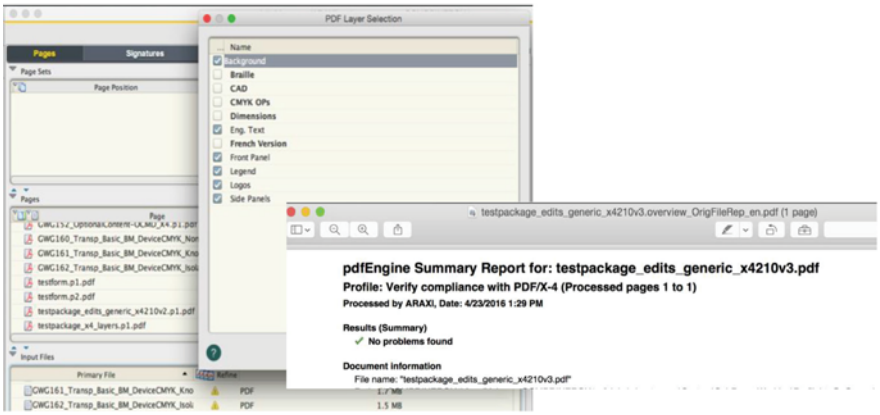
- layers for technical process such as die, dimensions, agency slug
- layers for content, language versioning,
- spot color to spot color gradients
- metallic spot color
- transparency, CMYK gradients on spots, including white ink
- variable data



sources: Andino 2015 Adobe Acrobat XI (CS 6) enfocus PitStop Pro v13

Figure 3: *Screen captures of 'The Daily Grind' CPG mockup in Adobe Acrobat XI (CS 6), showing Optional Content Layers and PDF/X-4 verification with enfocus PitStop Pro v13*

The results of this work verify that Adobe Illustrator CS6 is able to support creating and exporting an PDF/X-4 file, one that takes advantage of some of the key benefits of the format including mixed colour spaces, transparency, and optional content (layers).



sources: Andino 2015 Kodak Prinergy 7 Kodak Prinergy 7 'Preflight+

Figure 4: *Screen captures Optional Content Layers from 'The Daily Grind' CPG in Kodak Prinergy v7 and sample Kodak Prinergy 7 'Preflight+' PDF/X-4 verification report*

Further, the testing demonstrated that Kodak Prinergy 7 could be successfully configured to verify (preflight) for PDf/X-4 conformance, and to successfully process PDF/X-4 files. Layers can successfully be accessed, and selected as required, for further processing and output.

PDF/X-4:(2010) in the 'field'

The third part of the paper discusses perspectives on the relative uptake of the PDF/X-4 format in common industry workflows. Results from Magazines Canada' surveys concerning PDF X-4 in publishing workflows, as well as interviews and discussions with industry practitioners are used to develop a 'snapshot' picture of the use of PDF/X-4 files in the North American commercial, packaging and publishing sectors.

These discussions seek to identify and clarify if and how PDF/X-4 is being used to leverage the benefits it initially proposed; support for native transparency workflows, as well as color managed RGB workflows. They also work to identify environments where final X-4 files are being used as the 'record of truth', and being leveraged for cross media workflows. In addition they investigate the adoption and use of optional content layers in X-4 files in workflows.

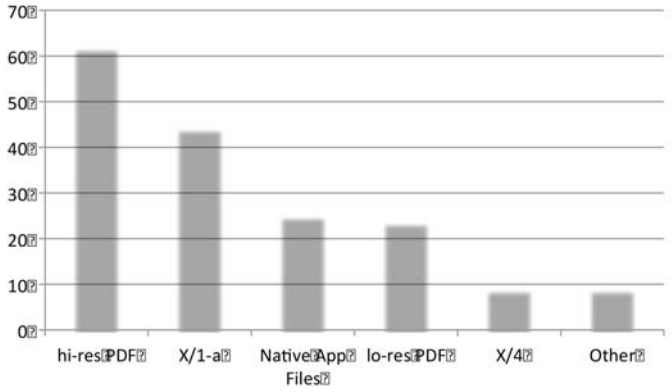
Magazines Canada PDF/X-4 Survey

Magazines Canada is a national, non-profit, trade association advocating consumer, cultural, specialty, and professional and business media magazines in the Canadian markets. Their 'Manufacturing Committee' maintains and develops 'Magazine Advertising Canada Specifications' (dMACS). The group also helps develop educational initiatives and best practices for the production of magazines (Magazines Canada 2011).

In mid 2013 they undertook a survey on PDF/X-4 perspectives in an effort to understand and gauge possible support for the 'newer' PDF/X standard (the author was a member of this Committee and Taskforce). There were two initial versions of this survey, one targeted towards Content Generators, and another towards Publishers. These results have not been published or released previously.

The initial survey results are valuable as a reference on the use of X-4 in 2013, approximately three years after its release. There were 34 respondents to the Content Generators and 28 respondents to the Publisher survey, primarily in the Canadian Market (Magazines Canada 2013).

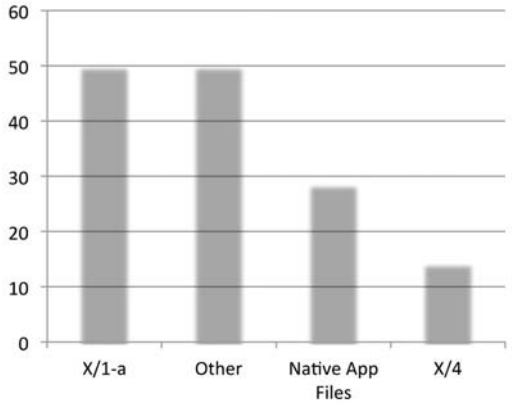
Content Generators were presented a list of file formats, and asked, "which of the following file formats do you use for file delivery" (respondents were able to select multiple options). PDF/X-4 was less than 10%, while PDF/X-1a was over 40%.



sources: Magazines Canada 2013 PDF/X-4 survey results

Figure 5: *Magazines Canada Content Generators PDF/X-4 survey File formats reported used file delivery (respondents were able to select multiple options)*

Publishers were also presented a list of file formats, and asked, "which of the following file formats do you use for supplied advertising material" (respondents were able to select multiple options). PDF/X-4 was slightly higher than with Content Generators, but still below 15%, while X-1a was at 50%.



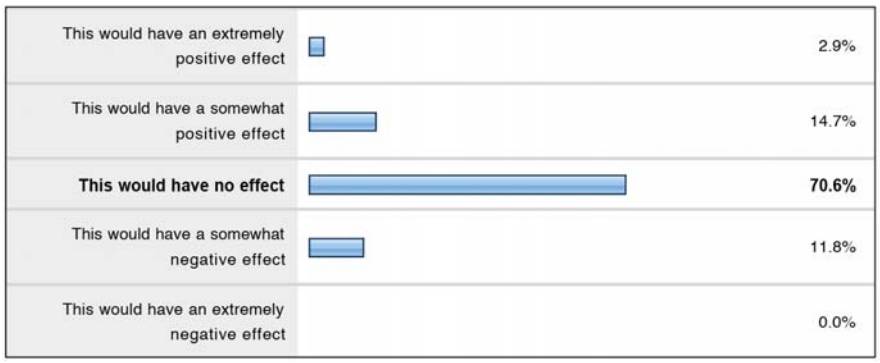
sources: Magazines Canada 2013 PDF/X-4 survey results

Figure 6: *Magazines Canada Publishers PDF/X-4 survey File formats accepted for supplied advertisements (respondents were able to select multiple options)*

Both groups were also asked, "If you don't use PDF/X-1a or PDF/X-4, are you aware of the [those] standards for file delivery?". Each group reported 35% awareness of PDF/X-4 while 58% of Content Generators were aware of PDF/X-1a. Interestingly only 50% of Publishers reported being aware of X-1a.

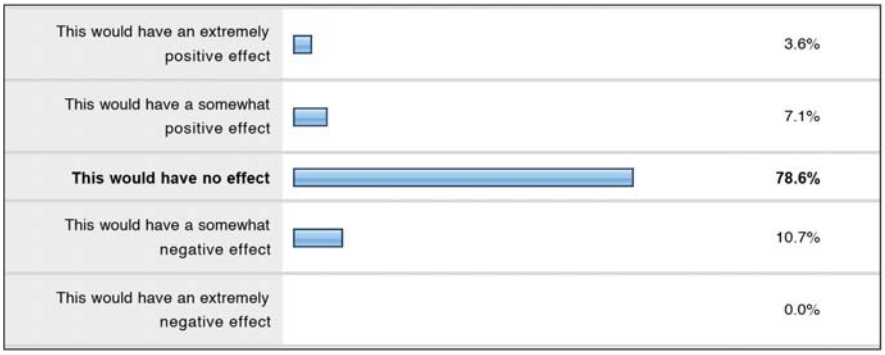
With regards to layers, just over 66% of Content Generators reported using them in layout applications, but only 14% reported using them in PDF files.

Content Generators and Publishers were both asked, "If your printer asked you to provide a PDF/X-4 file instead a PDF/X-1a file or 'regular' PDF file, how much would this affect your current workflow?".



sources: Magazines Canada 2013 PDF/X-4 survey results

Figure 7: *Magazines Canada Content Generators PDF/X-4 survey*
PDF/X-4 Impact on current workflow



sources: Magazines Canada 2013 PDF/X-4 survey results

Figure 8: *Magazines Canada Publishers PDF/X-4 survey PDF/X-4 Impact on current workflow*

In both groups over 70% or respondents reported switching to an X-4 workflow would have no effect, either positive or negative. Less than 20% in each group perceived adopting an X-4 workflow as a positive, and approximately 10% in each group reported that switching to X-4 could have a somewhat negative effect.

Overall, highlights from the survey reveal a relatively low awareness and adoption of the file. However Content Generators also reported areas of concern in their processes that could, in theory, be addressed by using a PDF/X-4 workflow, including creative limitations re transparency support, and layered workflows. Content Generators were asked "When creating print content, what would you consider to be the most significant factor(s) that restrict creativity (check all that apply)":

sources: Magazines Canada 2013 PDF/X-4 survey results

Figure 9: *Magazines Canada Publishers PDF/X-4 survey*
Significant Print Related Factors that Restrict Creativity

Current Perspectives – Interviews with Industry

A series of interviews were conducted in late 2015 and early 2016 with a variety of industry members, the majority located in Canada's largest market, the 'Greater Toronto Area' (GTA, population 6 million).

These workflow discussions, with Publishers, Printers, Content Generators (Agency and Packaging), were done in an effort to understand current use and support for PDF/X-4. In the majority of cases, contact and company names have been withheld.

Publishers

A Technical Director at one of Canada's leading Consumer publishers (Publisher A) was knowledgeable about the format, understanding the possible benefits to a cross media workflow (repurposing content for print to online), but was not using the format for either editorial or advertising workflow.

Re X-4, the Director asked, "What is the benefit? repurposing? [we] have the source files, we don't repurpose, we create from scratch".

With regards to switching supplied advertising files to an X-4 workflow from X-1a, the Director asked:

"To pick up that risk, is it worthwhile? – we have no problems at all – X-4 such a nightmare, stuff that goes in, problems we could have – [currently thousands of] pages a year, not one comes back, no anomaly in 5 years…[using PDF/X1-a]".

At a different, medium sized, Consumer publisher (Publisher B), the Production Director was also aware of the format, and its technical differences from X-1a. They are also not using it for either repurposing, or for supplied advertisements. The Director framed the concern around potential impact on the advertising community:

"In Canada [the three large CDN consumer publishers] would need to adopt it as an industry thing – for consistency, the market is smaller, don't confuse the advertisers more…".

Printers

The Pre Media Technical Director / Managers from three different leading printers, each with a mix of web, sheetfed, and digital equipment, were also interviewed. Their responses included Printer C who was unaware of the format;

'What's that?' - Never heard of it…". Printers D and E were aware of the format, and supported it. Volume wise, Printer 'D' estimated 15% of files were PDF/X-4, while 'E' reported a 50/50 mixture of X-1a and X-4.

Printer D spoke to internal benefits; with X-4 and the Adobe PDF Print Engine, it "fixed a lot of issues with RIPs and transparencies", they continued, "X-4s RIP faster…".

Both emphasized that they encouraged suppliers to use X-4, when given the choice, but that the 'major' publishers in Canada dictated X-1a's. Printer E discussed that several smaller publishers adopted X-4, as it eliminated the white 'artifact lines' (screen artifacts caused by transparency regions in flattened PDF files) from their digital editions.

Neither Printer was supporting X-4 files with RGB content, and neither could recall any reproduction issues with X-4 files.

Content Generators

From a packaging perspective, Stephan Jaeggi with PrePress-Consulting in Switzerland (pdf-aktuell.ch) spoke to his recently completed work implementing X-4 workflows for Novartis Pharma. Novartis successfully migrated their packaging production for 30 000 products, but Jaeggi notes "that's rare [for X-4] – customer suppliers [were] really forced to use it". Jaeggi continued, "transparency was key", the files are CMYK only, with no layers, "spot color used for technical colors".

The Workflow Manager at Content Generator F, a Toronto office of a multi-national involved with packaging and retail work, is aware of the format, but explains "we're not using X-4", the final file format "depends on the brand owner, the media house, and the final user".

A Production Consultant at Content Generator G, a packaging design firm, describes how they supply files to pre-press or printers; "it can be almost anything depending on the level the printer is at", from, collected or outlined [Adobe] Illustrator files to PDF/X-1a files all the way up to PDF/X-4". For those not wanting Illustrator files, the "majority of what we do - probably 90% - is still X-1a".

The Consultant continues, "occasionally we have a few printers which require files saved as X-4 files due to the complexity of the file (ones with lots of vector points seem to crash…) or when the original file size is enormous (2Gb plus files sometimes have given issues in the past".

The Vice President of Production for Content Generator H, a Design Studio for a multi national agency, echoes others; "we don't control print – we supply [file formats] based on the vendors, what do they want". They see "90% X-1a, 10% CFO" [collect for output - application files].

Finally, a Production Workflow Consultant for Content Generator I, a CPG manufacturer, uses layered PDFs (not necessarily verified as X-4s) for "internal approvals; marketing, legal, different departments", however the Consultant continues, "our final materials [to printers] are not PDFs, [they're] eps or DCS files…".

Workflow discussion summaries

Overall the discussions revealed a level of what could be termed 'X-4 apathy'. Aside from Printer E who reported a 50% use of X-4 files, the other Printers and Content Generators reported either no use, or numbers which generally aligned with the Magazines Canada survey almost three years earlier.

Both printers and content generators report similar perspectives, that the other was responsible for determining final formats, and therefore driving any migration to an X-4 workflow.

This is especially worth noting as every organization interviewed, except one, was utilizing a 'native PDF' workflow that could support transparency. However when X-4 was used, it was as an exception, either legislated by a client, or as a workaround to problematic situation, it was generally not the default workflow.

Understanding the proposed and potential benefits for X-4, re-purposing and transparency, late binding color workflows, and the potential for layers (Lisi - Smyth 2010) the potential drawbacks highlighted by some of the interviewees were investigated further.

Concerns with PDF/X-4

RGB workflows and Black Point Compensation

In the workflow quick look interviews; all final print workflows were based on CMYK. There were no RGB conversions on supplied final PDF files.

Some workflows were utilizing RGB upstream, but these were converted to the final output intent during the creation of final materials. Publishers using the same final PDF files for Print and online Digital Edition were using CMYK based content.

Black Point Compensation is a function designed to help address issues in color conversions that are the result caused by differences in the 'darkest' levels of black on different output devices (Adobe 2006).

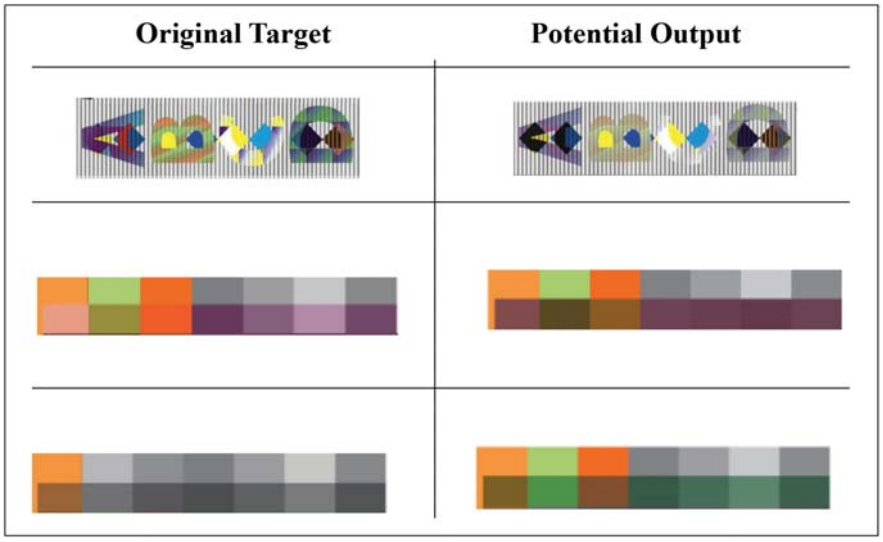
Concerns can come up when a color conversion is applied using ICC color profiles - while the ICC profiles adjust for the level of white, how the black is converted is not specified. This can lead to issues with the loss of detail in the shadow areas - images 'plug in'.

Part of the concern is that this is an optional feature that can be selected on, or off, in page layout and image editing software (Dov Issacs, personal communication, February 19, 2016).

Transparency and Flattening

Some of the industry members interviewed were concerned that X-4 was unreliable for output with regards to transparency. They supported the X-1a format, because the files were supplied flattened, and therefore offered more predictable reproduction with less liability.

This opinion is most likely the result of industry reports of possible differences in transparency flattening. This was identified and highlighted by the results of the VIGC PDF RIP tests in 2012 - the VIGC is the Flemish Innovation Center for Graphic Communication (VIGC 2012).



sources: VIGC PDF RIP tests 2012 en.vigc.be
original targets: Altona Suite www.eci.org/en/downloads

Figure 10: *VIGC Targets and potential Output through some correctly configured vendor systems*

Their results, based in part on European Color Initiative's Altona Suite test targets (www.eci.org/en/downloads), revealed discrepancies between how different workflow systems processed transparency. Further research by the group, vendors, and others revealed the underlying reason to be differences in how the original PDF specification was interpreted during software development.

11.3.4 Blending Colour Space

The compositing formula shown in 11.3.3, "Basic Compositing Formula," represents a vector function: the colours it operates on are represented in the form of *n*-element vectors, where *n* denotes the number of components required by the colour space in used in the compositing process. The *i*th component of the result colour C_r shall be obtained by applying the compositing formula to the *i*th components of the constituent colours C_b, C_s, and $B(C_b, C_s)$. The result of the computation thus depends on the colour space in which the colours are represented. For this reason, the colour space used for compositing, called the *blending colour space*, is explicitly made part of the transparent imaging model. When necessary, backdrop and source colours shall be converted to the blending colour space before the compositing computation.

11.7.2 Colour Spaces for Transparency Groups

As discussed in 11.6.6, "Transparency Group XObjects," a transparency group shall either have an explicitly declared colour space of its own or inherit that of its parent group. In either case, the colours of source objects within the group shall be converted to the group's colour space, if necessary, and all blending and compositing computations shall be done in that space (see "Blending Colour Space"). The resulting colours shall then be interpreted in that colour space when the group is subsequently composited with its backdrop.

source www.adobe.com/content/dam/Adobe/en/devnet/acrobat/pdfs/pdf_reference_1-7.pdf

Figure 11: *PDF 1.7 Reference Guide 'when necessary' and 'if necessary' are somewhat ambiguous and could lead to different outputs depending on interpretation*

The flattening issues seen generally involve RGB elements and blend spaces. Workflows that utilize only CMYK content for vector and raster content would not see the same concerns.

Layers - Optional Content

Layers are the ability to create, and support, 'optional content' for different viewing, printing, and processing uses. Support for layers was considered, through the initial Magazines Canada survey, as well as field interviews, to be a useful technique used by Content Generators in a workflow. However layers were generally used before final release materials were created - not in final PDF files.

Optional Content in Acrobat is supported through different methods. The fist, Optional Content Groups (OCG), can control different, multiple, elements, and these elements can belong to more than one OCG.

Optional Content Membership Dictionaries (OCMDs) are lists of OCGs, and were developed to provide a higher level of control over OCG groups, and their visibility. Lastly, Optional Content Configuration Dictionaries (OCCDs) are used to set up a predetermined configuration of OCGs – which groups are visible, and which groups aren't, establishing a 'default' state for the file when opened. This functionality is what is used in PDF/X-4 for named configurations; it was required in PDF/X-4: 2008, and made optional in PDF/X-4: 2010 (Rosenthol 2010).

These somewhat confusing applications and integrations of layers may be limiting their wider uptake in later stages of some workflows.

Conclusion

What's Next for PDF/X-4?

The Magazines Canada surveys, and to some extent the field interviews, revealed a lack of both awareness of the PDF/X-4 standard and knowledge of how it works. Those who did understand the benefits of the standard often felt that it was another group's responsibility to 'drive' the change, to request and implement X-4, as opposed to X-1a.

Understanding this, to help address these known issues and increase support and adoption of the PDF/X-4 format, different industry groups are taking initiatives.

In North America, Idealliance's SWOP group (www.idealliance.org/specifications/swop), is looking to help shift publishers perspective on X-4 to help drive adoption. They have a new Workgroup looking to create and support a 'PDF/X-4+' (PDF/X-4 'plus') specification that will help create reliable files for enable multiple end uses; Print, Digital Editions (Tablets), Marketing, and Archival. The proposed specification is CMYK only; the primary benefit is support for native transparency.

The Ghent Workgroup is close to releasing an updated set of their specifications for PDF/X-4 workflows, to be called GWG2015. Expected in the second quarter of 2016, these will offer support for RGB in PDF/X-4, and could provide a structure for late binding color workflows (Stephan Jaeggi, personal communication, February 23, 2016).

As well, a new standard, 'ISO 19593-1 Use of PDF to associate processing steps and content data' is in later stages of development (ISO 2016). This new standard is designed to use layers to support packaging based workflows currently using spot colours to store processing info ("varnish", "die"). The goal is to put this information onto layers, where the names are not defined, but the PDF metadata is defined, meaning what the layer is used for is universal, but how it is visibly identified to the user can be. A preliminary version of the standard already exists in the current version of Esko's Art Pro packaging design and layout software (v14.1) (Esko 2015).

PDF 2.0

The current version of the PDF Library, 1.7 was originally released in late 2006 (source). Adobe donated the specification to the ISO in 2007, and in 2008 it became ISO 32000-1:2008. The ISO TC 131 group is currently in the final stages of developing an updated version of the PDF library, 2.0.

Importantly for PDF/X files, part of the changes in this updated library are to "clarify the 'contentious' aspects of the existing specification", to "reverse engineer and detail 'what did Adobe actually mean?' in the specification", with regards to how different groups and blending spaces should be handled (Dov Issacs, personal communication, February 19, 2016).

PDF/X-6

The next version of PDF/X will be based on PDF 2.0, and is being developed in parallel. It will build on PDF/X-4, but will be 'fine tuned' and offer some additional functionality important for print based workflows. (Issacs xxx).

One change includes adding support for 'output intent on a per page basis'. The existing subset PDF files (PDF/X, PDF/A) require an output intent profile (for example SWOP, Fogra, or others) that applies to the entire document. The new PDF/X will offer support for different output intents for any or all part pages, with the ability to override the document one. This has potential benefits for periodical publishing (partial ads), as well as variable transactional (PDF/VT) projects (Dov Issacs, personal communication, February 19, 2016).

Although not part of the PDF/X-4 specifications, PDF/X-6 will also specify how Black Point Compensation should be addressed.

Both PDF 2.0 and PDF/X-6 are in the final stages of review and approval, and could be published later in 2016/2017.

Opportunities for Further Study

When software tools for the new standards, PDF 2.0, and PDF/X-6, are available they could provide opportunities for further research. This could include helping to develop new testing tools, and the development of best practices and case studies.

If different areas of the industry promote an educational initiative to promote awareness of the benefits, and ultimately adoption, of the new PDF/X-6 format, it would be useful to research on relative uptake and report on case studies. This could be used to help refine and revise further awareness/promotional approaches.

There also may be opportunities to research how vendors are supporting their clients, with these changes. How they ensure their people are knowledgeable about the formats, and if they advocate the newer technologies, how they can help adapt existing workflows. As noted in testing the Kodak system, there are a myriad of settings that require attention before migrating from X-1a to X-4.

Further in the future, testing any sub variants of the new X-6 that support N colorants could be of interest to both Brand owners and Packaging printers, with reported increased interest in expanded gamut printing (CMYK plus 2 or 3 a dditional inks).

The new format(s) could address some of the major concerns that might be responsible for the relatively limited uptake on PDF/X-4, and ultimately help address concerns in the value chain surrounding liability.

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