

Automation in Color Workflows

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Abstract

Due to the increased use of color in digital printing environments and ongoing digitization in the traditional print markets, digital color is becoming ever more important. Color however is about emotion, which seems to conflict with the emotionless automatic transformation of color spaces to which color handling is often reduced in this digitization process. Furthermore we observe that the control of output moves upstream from the operators to the pre-press and even to the creative people responsible for the design. Considering the above, it is ever more important to enable a good communication along the complete production process. In order to get a good translation of the designers' wishes to the output device we have investigated all steps in the evolving color workflows. This paper discusses the different steps encountered in color workflows of professional environments and the trends in automation, which are introduced to support an efficient handling of these steps. Topics include hybrid workflows, Color Management, automatic document assembly and overall process control.

What is Color Workflow?

The term workflow is very general and therefore it is important to give a clear definition of our view on a color workflow. In this paper we take a workflow to be the end-to-end sequence of steps, which are taken from the creation of a file to the production of the desired output. This output could simply be a printed document, but also a complete finished book or a laminated and mounted poster. From information gathered from a wide range of professional clients, we have distilled a generic color workflow scheme on how jobs are processed nowadays. This can be seen in Figure 1. This generic scheme takes offset as well as digital printing into account. In this part different processing steps can be distinguished in each generic workflow phase. Some typical steps are listed in Table 1, where each step is assigned to one of the generic phases. Since some of the steps are similar between offset and digital printing these are taken together.

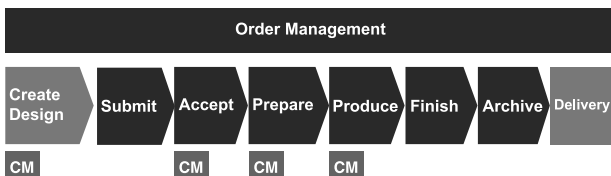


Figure 1. General workflow scheme.

As can be seen many of the steps are done in both offset and digital environments and this shows that there lie opportunities for combining workflows for both environments.

Table 1. Overview of Typical Workflow Steps

Workflow phase	Offset	Digital
Submission/Acceptance	- Pre-flighting - Proofing	
Preparation (Pre-press)	- Imposition	- Page and Image Editing Tools
	- File conversion (e.g. to PDF) - Image/Color Enhancement - Trapping - Color Management	
Production	- RIPPING - Output management	
	- Making plates/films	- Load balancing - Color Splitting
Other	- Finishing - Archiving - Accounting	

Automated Color Workflow

Since all of the above listed steps can be implemented by software, complete software solutions have been developed. These encompass solutions from offset related companies as well as digital related companies. Examples of the former are Prinergy (Creo), ApogeeX (Agfa) and Prinect Prepress (Heidelberg), while from the latter there are solutions like OneFlow (EFI), and PRISMA (Océ). With these solutions it is possible to build customized complete workflow systems, where the printing of a job can be automated from file intake till the sending to a CtP device or digital printer. This increases efficiency, but also makes sure output is consistent since every process is handled in a similar way.

Next to the ongoing digitization, developments in digital printing technology have been such that ever-higher run lengths can be addressed (due to increased printing speed and lower costs per print). Combined with the trend towards lower run length printing of traditional printers due to automated pre-press software and CtP devices, this has resulted in an overlap of the traditional and digital printing markets. Therefore for many print providers it has become more attractive to supplement one type of technology with another. As a result some complete workflow solutions have appeared, which are able to support both types of workflow. This sort of workflow is

called a hybrid workflow and examples (with a legacy from different markets) are EFI OneFlow and Prinect Printready (Heidelberg). Similar to the combining of offset and digital printing, one could imagine a hybrid workflow, which enables cross media publishing.

The trend towards the overall steering of different printing technologies is reflected in the design of a standard file format called JDF (Job Definition Format). With this format it is possible to connect the different elements of the workflow together within one file type. While the above mentioned complete workflow solutions are already complex for customers, here it seems that they really are getting into problems in keeping up with the ongoing automation. Although JDF indeed has the potential to form the cement for the future printing environments, its penetration in the market is very slow. A solution like this has an added value in environments, which already have made a step towards the streamlining of their processes. Therefore it must be kept in mind that the implementation of JDF in a workflow makes it more efficient, but not more effective. However, since the implementation of a complete JDF system could be spread out over years, it is good to already take it into account in new products.

Color Management

Due to the introduction of ICC based Color Management, the handling of color can be automated by the use of ICC profiles. The concept of Color Management is essential in an automated color workflow, since this enables a consistent and accurate color output independent of the input and output device. At the same time a good workflow is also essential for a correct employment of Color Management. This can be seen in Figure 1, where each phase where Color Management can be employed is indicated (CM added to the relevant phases). Since this occurs at several places the danger is the stacking of Color Management actions, where each action is not aware of earlier actions. Although in theory in a good workflow the use of profiles is tuned, customer visits have taught us that in practice for many sites this is not the case. This is not only because of bad communication between different steps in the printing process, but also due to lack of transparency in the employment of Color Management itself. Sometimes Color Management is done automatically without the wish and/or knowledge of operators. This is due to the lack of clear feedback to the operator combined with the fact that Color Management modules in general are dumb: they simply perform color transformations specified without realizing whether these are appropriate or whether this will yield a good output.

Therefore one must realize that although the correct use of Color Management could be helpful, the understanding and experience of an operator regarding the wishes of customers will stay an important input in the correct translation of the emotion of the customer in the final print. However whenever automation is wishful (e.g. due to time considerations) it could be useful to learn from the behavior of experts to get an approximation of the

wishes of a general customer.¹ With the above mentioned trend towards hybrid workflows, extra attention towards Color Management must be paid since the output should be handled correctly for different devices. These have different gamuts, or even different types of output color spaces (RGB versus CMYK in case of cross media publishing).

Automatic Document Assembly

Another interesting example of automation in workflows is that where the combination of static and dynamic elements is done automatically in the workflow (also called Variable Data Printing (VDP)). Although the simplest manifestation of this is just black and white mail merge, there are many more complex cases. Recently there has been a trend towards full color VDP, where the complete content is dynamic: from background till separate images. This is especially driven by a trend towards more personalization in marketing and tailored communication, in order to increase return on investment. As individualized documents can only be processed digitally, this is one of the important reasons for a shift from traditional offset towards digital printing. Also here there is a trend visible that different applications run through the same workflow. This can be seen by the convergence between document printing and transaction applications.

Many of our customers see potential in Variable Data Printing, but a problem is that their existing document-printing infrastructure is not suited for this. It could take many jobs to keep a digital printer running on VDP jobs. Therefore it takes a good deal of automation before all these jobs can be handled efficiently, without losing the overview of what records are printed and what has to be paid for. Moreover, it is difficult to find the right application; it is not only necessary to select an application on its specifications, one also needs to verify whether it fits in the existing workflow and whether it yields an added value for the end-users. An extra problem here is that it can be difficult to find solid reliable content for the variable data. Records can be outdated, or it proves impossible to get the right cross section of the interesting target audience.

Concluding, it looks like a digital printer in this industry needs the right workflow, find the right customers and come up with the right applications for them. If one does not have the answers for all these dimensions, then it could prove tough to compete in the variable data printing market.

Since it is complex to set-up a successful VDP system, this makes VDP solutions a good product for companies that have a close customer contact (direct sales & service), have a good overview of all relevant components and are able to assist in implementation issues (solution delivery process).

Conclusion

The digitization of the productive printing industry has led to many examples of automation, which helps customers as well as operators in the handling of jobs. Important examples are in overall process control (complete software workflow solutions), color handling (Color Management) and automatic document assembly. Although the benefits are obvious, also some dangers can be discerned. This is expressed in the creation of too complex workflows and standards for complete solutions, and non-transparent and wrong use of Color Management. In the design of applications extra attention to these aspects has to be given. For automatic document assembly finding the balance between technical implementation, the right applications and the right business model can be an additional challenge.

References

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Biographies

Eelco Schillings (1973) studied Physics and Art History at the University of Utrecht for which he received his degree in respectively 1997 and 1998. In 2003 he obtained a PhD in Physics on research done at CERN, Geneva. After that he started to work at the Research and Development department of Océ in Venlo, where he is doing research in the field of color workflow and image processing.

Klaas Jan Wierda (1972) studied Applied Physics at the University of Twente, for which he received his degree in 1996. He also studied Cultural Anthropology at the University of Utrecht. Since 1997 he has worked in the Research and Development department of Océ in Venlo. Currently he is focussed on digital front end and applications for color printers.