

Asymmetrical collaboration in print shop-customer relationships

Jacki O'Neill¹, David Martin¹, Tommaso Colombino¹, Jennifer Watts-
Perotti², Mary Ann Sprague², Geoffrey Woolfe²

Xerox Research Centre Europe, Grenoble, France¹

Xerox Research Centre Webster, Rochester, USA²

{firstname.lastname@xerox.com}

Abstract. The service provider-customer relationship, although not perhaps considered a typical collaborative relationship, is clearly collaborative work. However, such work is constrained by the very (service) nature of the relationship. Customer-service provider interaction can be characterised as interaction at the boundaries of organisations, each of which is likely to have their own workflows and orientations. Many service organisations attempt to facilitate this interaction by configuring their customers, using standardised forms or applications. In this way they bring the customers workflow into line with their own. In this paper we describe field work examining one particular service relationship; that between print shops and their customers. A notable feature of print shop-customer relationships is that customers prepare the material that the print shop then prints. This makes the standardization of workflows difficult, particularly within the service relationship. Technologies exist which aim to automate and standardize the workflow from customers to print shops. However, they have, up to now, largely failed to live up to their promise, leaving print shops to adopt ad hoc solutions. This paper describes the hidden work that the print shops do to make the service relationship work.

Introduction

The service relationship, between service provider and customer, is an important one for CSCW. Although it may not typically represent what we think about when we talk about collaboration, examining the customer-service provider interaction demonstrates that it is clearly collaborative work (cf. Hughes, Randall & Shapiro, 1991). Such collaboration may be necessary for that service relationship to work,

but at the same time it is constrained by the very (service) nature of the relationship. It is not one of straightforward cooperation with both parties on an equal footing, and the relative responsibilities for ensuring a satisfactory service provision for both sides may be unequal. This is especially true in the print industry where, as we shall see, the service relationship is maintained through collaborative work to make the artefacts from the customers workflow fit into the print shops workflow. The asymmetry in the collaboration comes from the print shop taking on the bulk of the work to make the service relationship work. In this paper, we explore this asymmetrical collaboration between print shops and their customers.

In business there is an increasing move to remote channels for service provision, with organisations interacting with their customers using information and communication technologies (ICTs), the Internet and so on. In addition many service organisations have technologically managed workflows and thus make use of on-line forms, standardised files and applications – web interfaces and such like – in an attempt to create a smooth process across organisational boundaries, minimising the need for face-to-face and even telephone contact. In this Internet age large portions of the service sector now do business online from government services to on line banking and insurance. A recurring theme with industries that have made this change is that moving customers to remote channels may be highly profitable but that doing so requires some re-configuration of the relationship with the customer and carefully thought through technology design (Bowers and Martin 2000; Rouncefield, Harper & Randall, 1999). Focusing on printing we see that it is a service industry that is moving in this direction. Technologically managed workflows are being widely adopted. Job submission is often remote, with files frequently being sent by email. In addition many print shops are seeking to conduct more business online, whereby customers submit jobs using standardised templates. In some areas, attempts have been made to fully automate aspects of the workflow so that collaboration between print shops and their customers is minimised. Many jobs are submitted as ‘ready to print’, that is, jobs which can be printed out and dispatched to the customer with, in theory, no extra work required to prepare the document for printing on a digital production press.

Digital print shops cater for a wide range of customers with diverse requirements and this is part of their selling point. However, that very diversity of customers, as well as the service provider role, presents problems in process standardization and movement to remote channels for customer-organisation interaction. Their customer diversity means that it is difficult to employ standard workflows across various customers and consequently learning and re-use from customer to customer is not optimised. Moreover, the service banner means that they are often involved in doing extra (often not ‘costed’) work in order to produce a printed product that is good enough in terms of content and aesthetics.

In this paper we report on a series of ethnographic studies of digital print shops which examine the print shop-customer relationships from the side of the print shop. For CSCW, the paper provides some interesting new material on problems and concepts that have drawn interest for a number of years:

1. How do we understand the nature of cooperative work in customer-organisation interaction, and what does this mean for process and technology integration?
2. What is the work involved in supporting cooperative (service) work across organisational boundaries? What is the work involved for service organisations (and customers) when their workflows do not match?
3. To what extent can print shops configure their customers (cf. Woolgar 1991; Bowers and Martin, 2000), in the sense of both better understanding the customers they work for and in getting their customers to interact with them (preferably through technology) in standard, tractable, predictable ways?

In the print shops we noticed a large amount of extra ‘collaborative’ work was involved in the print shop-customer relationship. The print shops in particular undertook much work to make the service relationship work. As we shall see this collaborative work goes on despite attempts at automation. Much of this work comes about because the customer, or some agency working for the customer, prepares the files which the print shop must turn into a finished product. The customer creates the file within their own workflows and according to their concerns and then passes the file to the print shop. The file then enters the print shop’s technologically supported workflow through which it passes to become a finished product. As we will explore in this paper, the two workflows often do not converge well, despite there being, in some cases, tools designed to support (or partly automate) the workflow from customer to print shop. This non-alignment of workflows creates additional work for both print shops and customers, although the bulk of this work is handled by the print shop. In this paper we will explore the solutions implemented by the print shops in an attempt to address the problems caused by the disparate workflows and their contingencies, within the constraints of a service, rather than a straightforward collaborative, relationship.

Related work

Studies of the workflow and workflow technologies in print shops are not new to CSCW. Papers by Bowers, Button and Sharrock (1995) and Button and Sharrock (1997) examined workflow and communications technology in large print shops. This work examined offset printing which poses different challenges to digital printing. Even so we can see that the use workflow technology, has long been a facet of print shop work. These papers clearly reveal the problems that such systems can introduce *within* the print shop organisation. In this paper, however, we focus on the customer-print shop interaction *across the organisational boundary*.

Although over the years technological innovation in both workflow and communication systems has moved on, we will see in this paper that technology has by no means solved all the challenges.

There has been some research in CSCW that has addressed the customer-service provider relationship, most notably in the banking sector (see, for example, Hughes et al (1999)). One notable feature of many of these papers is their consideration of how the technology is used by the bank to configure the customer (see also Bowers and Martin, 2000). Some research has considered the customer-service provider relation in the printing sector, but has focused on the interaction with the customer around technical support (Whalen & Vinkhuyzen, 2001; O'Neill et al, 2005) or around sales and support (Whalen, Whalen & Henderson, 2002).

There is one essential difference, however, between these service relationships and those discussed in this paper; that is, here the print shop customer often prepares the file or the components of the file that the print shop is to print. In the technical support and banking situations any shared artefact that is created can be strictly controlled by the service organisation. For example, banks have standardised forms or internet banking applications which the customer must complete or use to access the banks services. These forms and applications are the external face of the service provider's organisation, they are designed to be a bridge between the customer and the service provider and specifically to fit with the workflows of the service organisation. They could be considered to be what have been referred to elsewhere as boundary objects (Star, 1989; Star & Greisemer, 1989).

The print shop situation is different because, in most cases, such a standardised object does not exist, rather the client prepares the file in their workflow and the print shop prints it in theirs. Various attempts at standardisation have been and continue to be made and these will be examined in this paper along with other methods for dealing with the issues that arise. One major attempt at standardisation is 'colour management' (discussed below). However, as is often the case when two (or more) diverse organizations attempt to integrate and standardise the process between them through the implementation of technologies, difficulties often arise (Martin et al. 2007; Lee, 2005). More often than not this is due to not fully considering the *social* – the work practices of those on both sides and in particular those at the organisational boundaries – in the design of the *technical* (see Woolgar, 1991). Resolution of these difficulties tends to (re)involve the social, that is the various parties work together to come to some solution. This suggests perhaps that rather than attempting to automate processes which are currently collaborative, tools which facilitate the collaboration may be more appropriate. At the very least, we emphasise once again that a careful consideration of the social nature of the processes to be automated is essential for success.

The print shop studies

During 2006 a multi-sited ethnography of digital colour production print shops was carried out in the US and Europe. Observation was carried out in six sites: four commercial print shops and two printer testing sites. The print shops varied in size, customers, core business and workflow organisation. The ethnography consisted primarily of observations, with total time on site around three months. The observations were supplemented by some in-situ interviewing and data was collected through field notes, digital photographs and video and audio recordings.

During these studies we noticed that a large part of the work of the print shops was managing the files that they received from the customer - be they assorted pictures and text for creating a document, data files for variable data printing, or 'ready to print' files. This in itself is not strange, however what struck us was the amount of routine work that went into fixing problems with the files which originated upstream at the customer site. This work turned what might at first glance be seen as a simple service relationship into a relationship requiring collaboration, moreover this collaboration was asymmetrical, with the print shop doing much of the work to rectify problems caused upstream, with much of this work, and even at times the existence problems, being hidden from the customer.

Digital production printing offers the promise of high quality prints in short runs, on demand, often from files submitted by customers. However, for such printing to be cost effective and timely, the submitted files need to adhere to certain characteristics, for example, to have international colour consortium (ICC)¹ colour management profiles attached, which our studies and others (Riordan, 2005) show rarely occurs. Where the customers do not submit files suitably adjusted to fit the digital production printing workflow, the print shops must engage in considerable work to make the workflow work. They are in addition constrained by the service relationship, limiting to some extent their ability to 'configure' the customer or certainly all customers, such that they receive 'suitable' input into their processes. In the following sections we will examine the work the print shops do currently to address the everyday troubles of making the files ready to print.

Exploring print shop-customer relationships

Digital production printing has advantages over traditional offset printing for both black and white and colour prints in two main areas 1) short runs (approx. <2500 prints) and on-demand printing, where the cost and set up time of offset printing can be prohibitive, and 2) variable data printing, where the printed output

¹ The ICC - <http://www.colour.org/> - is a body set up by several large players in printing and associated industries which has set up standards for colour management

changes, often for each item e.g. promotional material individually tailored to each recipient or bills and statements.

A variety of workflows and divisions of labour can be found in digital print shops. Such print shops typically consist of sections covering *sales*; *pre-press* - where work is carried out on the files to be printed, their components or the data prior to being sent to the printer; *production* - where the printing itself is carried out; *finishing* - turning the printed pages into the end product (booklet, letter, etc.); *dispatch* and *billing/accounts*. Print shops may also include graphic design sections. The division of labour and workflow varies across print shops, with roles being combined or separated out. For example, pre-press in some print shops is separated from production both physically and in the division of labour, whereas in others there may be different areas for pre-press and production but the same people working both. Our study covered print shops with both separate and combined pre-press sections. Most print shops have implemented some sort of workflow tool(s) to manage the flow of work from the customer, through the sections described above and back to the customer. Digital printing is a highly competitive environment and digital print shops are constantly looking at ways to improve their processes and offer new services, with technology at the heart of this process.

In this paper, we will be examining workflows within each of two areas:

1. *Workflows for high-quality colour digital printing*. Such printing typically consists of short runs and may or may not be subject to a short turn around time. An additional feature of some of the jobs we examine is that they are submitted as 'ready to print', that is, as files that can in theory be printed straight off without requiring any additional work and are costed as such.
2. *Workflows for variable data printing*. Such printing ranges from large black and white jobs such as bills to simple colour jobs such as place cards and complex colour jobs such as promotional mail outs, pension statements, etc.

In examining these workflows we will describe the everyday troubles (the "normal, natural troubles," if you like (Garfinkel, 1967)) that the print shops encounter in dealing with the content submitted by the customer.

Workflows for high quality colour printing

The colour managed workflow

The aim of digital colour printing is to produce high quality, consistent colour prints which the customer is happy with. In principle, ICC colour management is meant to assist greatly in achieving this. Reproducing colour across devices (monitors, printers) and on different media (LCD, paper, etc.) is a complicated business and colour management is a technology designed to enable translation

between different colour spaces² and colour devices (monitors, printers, etc.). This is necessary to ensure that a colour shown on one monitor or printed on one device (e.g. the customer's office printer) will appear the same when printed on another device (e.g. the print shops production printer). 'ICC profiles' should be attached to the file at creation and then can be interpreted by any other device to accurately represent the colours in the file.

The aim of the colour management system is that the communication of 'perceptual intent' between customer and print shop is automated. The print shop should be able to receive the files from the customer and print them out to achieve colour that the customer is satisfied with, without having to engage in lengthy colour adjustment work. Unfortunately, colour management is a complex technology that many people find difficult to understand and use. Furthermore, successful colour management requires both the document designer and the print shop to rigorously follow all ICC colour management procedures and use fully colour calibrated and characterized displays and printers. Colour management tools are rarely used as intended (Riordan, 2005) In our studies none of the files received were treated as part of a colour managed workflow. Some of the reasons why it is not used are: (1) it is a fragile (non-robust) system requiring strict adherence to procedure throughout the entire colour document lifecycle, from conception to consumption; (2) it requires that the customers' monitors are calibrated and that the customers attach the appropriate colour management tags to the files; (3) this fragility is exacerbated by the technical complexity of the current system, its tools and their user interfaces, all of which can easily overwhelm users without considerable training in colour science; and (4) colour management requires that the customers do work at their end to make their files fit into the workflow of the print shop, when they may not even be aware of this workflow and its requirements. For the print shops, because the files they receive lack usable colour management tags, the system cannot be used as intended.

Ad hoc solutions to non colour managed workflows

The print operators nevertheless have to try and get good quality colour prints. In some cases they might have a hard copy proof which they are trying to match. In other cases, where no hard copy is provided, they do not know just what colours the customer wants (their 'perceptual intent'). This is because the customer's screen or printer may be calibrated differently, which will affect the appearance of colours. The print shops we observed had put in place different ad hoc solutions to get around the problems caused by a non-colour managed workflow, we will examine two of these solutions here; manually adjusting the colour and customising

² Colour data is represented using numerical colour spaces, each space being a language to describe colour. The same numbers can be used in different colour spaces to represent different colours, thus the same set of colour values will look different in two different colour spaces.

the libraries of specifically defined ‘spot’ colours. These are two distinctly different approaches taken by different print shops which fitted in with the make-up of their customers and contracts. Elements of each of these approaches were seen at the other sites that we studied.

The manually adjusted workflow

One ad hoc solution to achieving desired colour despite the lack of colour management information was a manually adjusted workflow, in which operators manually adjust colours in the file, and then print it out to see the effects of their adjustments. This is an iterative process that can result in significant time spent before an acceptable print is achieved. This manually adjusted workflow can be performed in prepress or at the Digital Front End (DFE), which is the computer that drives the print engine. When done at the DFE, operators must perform manual aesthetic adjustments using tools that were designed to perform automated mathematical transformations using colour management tags. When done at the DFE, tools such as *tonal reproduction curves* (TRCs) which make adjustments to concentrations of individual colours and *emulations*, designed for the colour managed workflow, which make changes to the whole file, are used. To illustrate the difficulties of the manually adjusted workflow we will describe the use of emulations.

Choices for alternative colour spaces are called emulations in the DFE interface. A change from one emulation to another effects all of the colours in a file, often in unpredictable ways. In our studies emulations were frequently used by the print operators for aesthetic control, even though they are not designed for that purpose. The problem with this is that the effect is difficult to predict and categorical rather than directional. Hence the outcome of one test emulation, if not fully satisfactory, will not necessarily inform the user on which steps should be taken next.

Different print shops used emulations to different extents, however all the shops observed used them for aesthetic control rather than as part of the colour managed workflow they were designed for. The internal testing site tried each job with a number of different emulation settings to get the best colours possible. This shop was a special case since their aim was to show the colours that could be achieved by the printer to the best effect. Whereas in this internal site we observed up to seven emulations being tried on a single job, in the commercial print world we did not see more than three emulations being tried on one job, with the ultimate choice often being a compromise between some aspect of colour or image quality. This is because the commercial shops do not have unlimited time and manpower to spend on each job and proofing is a costly process. Of the commercial shops, two use emulations extensively whereas two shops used them more rarely, having developed other systems for colour control.

In the next section we will describe the the printing of an interior design catalogue at Europe1 to illustrate the work that the print operators must do to achieve good quality colour.

Interior design catalogue

In this job, the interior design catalogue came as a ready-to-print file i.e. one not requiring work by the print shop, with a hard copy proof. In theory the print shop could have just printed out the entire run, however they on looking at the file they predicted some potential problems and carried out some proofing. As predicted there were problems with the colour between the customers proof and the print shops proof. The print operator then had to undertake extra work to produce a good quality output, this work is hindered by the tools available and is hidden from the customer.

In this example we can see some of the difficulties of using emulations for aesthetic adjustment, in particular trying to find a good balance between the different parts of the document whilst using a transform that applies to the whole document. In this case the print operators had a hard copy proof submitted by the customer to match. A first print was printed using Direct (which takes the settings straight from the file). However, the colours of the catalogue did not match the hard copy closely enough, for example, a pink background was considerably lighter than the hardcopy proof. The print operators then produced a subsequent proof using an emulation called Euroscale. This produced a closer match to the colours in the catalogue but a considerably less deep and rich black on the front and back covers of the catalogue. The print operators attempted to get around the problem with the black by making some adjustments to the way in which the emulation was applied. The parameter pane for the selection of emulations at the DFE, allows for some selections that modify how the transform is applied to the document, so the print operator, using Euroscale (which provided the best colour match) selected the options to “Preserve pure colours” and “100% Black TextGraphics”. The rationale of the selection was to bypass the transform the Euroscale emulation was applying to the 100% black process colour background on the front and back covers, thus changing the way it was being printed. This in fact worked, with the exception that the parameter selection did not affect a small tiff logo with a black background present on the front cover, producing a clearly visible gradient between the black cover and the black in the tiff logo. This contrast between the two blacks was seen as an unacceptable outcome. However, to get a rich black the print shop would need to use Direct, which gave poorer coloured images. In this case the print shop decided to prioritize the quality of the images in the catalogue over the richness of the black of the covers, having been forced to choose one over the other.

We saw many other examples of compromises being made between one part of the document and another. For example, in another print shop, US1, an operator

was tasked with printing an advertisement containing people holding a tray of biscuits. Given the current tools, adjustments to optimize the look of the biscuits made the people's faces look very pink. However, when the faces were brought back to a more normal hue, the biscuits began to look too yellow. This occurred because the biscuits and faces had the same percentage of yellow in the colour mix and the tools only operated on the entire page, hence if you changed one it affected the other. The operator eventually compromised by creating a print in which neither the biscuits nor the faces were optimal. A frequently used heuristic by the print operators is to prioritise flesh tones, however, because the aim here was to sell the biscuits, the colour of the biscuits somewhat overrode this. It may seem that compromise such as these may be easily pre-specified by the customer, however, as we will see customers 'perceptual intent' is often only worked-up as the contingencies and compromises of any job become apparent.

Better tools could be designed to support the actual workflow between customer and print shop, rather than leaving the print shops to develop ad hoc ways to get around the problem of producing high quality colour prints from customer's files. However, better tools would be unlikely to eliminate the extra, hidden work that the print shop must carry out, although reducing it would be advantageous.

Customised spot library

Another print shop, Europe2, attempted to get colour consistency and quality by customising the spot colour library on their printer for some of their customers. The spot colour library allows operators to define specific cyan, magenta, yellow and black (CMYK) values for specific named colours within a file³. Many of their customers were long-term customers whose prints used standardised colours which remained consistent across jobs. For example, a major customer, who we will call 'Home Seller Collective' (HSC) represented a large group of solicitors who printed out window cards, leaflets and so on, illustrating houses for sale. Each of the solicitors had their own template, with their own colours, e.g. logo, border colours and so on, into which the pictures and text about the property were inserted. This was done by HSC who then transferred the resulting PDF files directly to a shared folder on the print server. The files were submitted as ready-to-print and, in theory at least, all the print operators had to do was to print them out and pass them onto finishing and dispatch. These jobs came in daily, throughout the day, and tended to be short runs (between 1 and 50 copies), however a large number of jobs could come in on any one day. These jobs had a very short turn around time (a few hours at most), being submitted to one of a number of deadlines throughout the day. HSC jobs are run under tight deadlines and there is no time for customer and print shop to engage in a proofing cycle, however the cus-

³ Printing involves creating colours from the basic four colour palette (CMYK) on the basis of combining toners or inks.

customer demands high quality consistent colour and keeping the contract relies to a large extent on Europe2's guarantees that they can provide this to tight deadlines.

When the current printer was purchased, Europe2 engaged in a collaborative process with the customer to try to introduce some predictability into the colour workflow. The customer sent a sample file to the print shop, with the background colours specified as spot colours. The print shop then printed a proof and sent this back to the customer. The customer returned the proof with comments on the colour such as 'Different colour of red needed'; 'Green should be darker', etc. The print operators made adjustments to the spot colour library according to these comments, re-proofed and returned to the customer. This went on for a number of cycles and took an extended period of time to complete for all the solicitors (a couple of months). The finally approved hard copy versions of the files were kept in a 'bible' next to the printer to be used for colour matching, although the print operators rarely used it having become familiar with the colours for each solicitor. The customer then used the templates with the specified spot colours to submit their jobs. This process did provide a level of consistency, however problems with colours did still arise – often with the photographs and such like which were not covered by this process - which then had to be addressed with the same manual adjustments described above.

Here the print shop engaged in a long-term collaborative process with their customer to ensure good quality prints through the setting up of a spot colour library. In doing so they emphasised the benefits to the customer of working to produce an aligned workflow – consistent colour on a short turn around time without proofing. So here the solution was a moving of the two workflows, print shops and customers, together through a process of (partial) standardisation. Taking, for example, the concept of configuring the customer, the print shop could be said to have configured the customer *and* themselves such that they could achieve a smoother, more consistent workflow. As a solution it is only suitable for long term contracts with clients who are willing to work with the print shop to achieve a fit between workflows. In addition, there is a trade-off between the predictability introduced by customising the spot colour library and being able to use the printer flexibly for whatever colours a particular job might have. In effect Europe2 were doing their proofing in advance.

Proofing as collaborative work

In the case of the interior design catalogue discussed above, the print shop had a hard copy proof they were trying to match and so they carried out all the proofing cycles internally. They did not engage in a proofing process with the customer. Even so this process is costly. All the sites used the production printer for proofing. Thus, not only is there the cost of the materials and the direct time of producing the proof to be taken into account but this also takes the printer out of production runs. Proofing, along with all the other work of the print shop, needs to be

considered in the constraints of the print shop as service provider. The print shop must of course attempt to do the best possible for each customer, but just what that ‘best’ consists in is not a matter of quality alone, rather it is quality in the context of time, money, customer relationships, expected ongoing business, urgency, etc. hence the compromises described above.

In many other instances, both where hard copy proofs are provided by the customer and when they are not, the proofing cycle involves the customer. In these cases the print shop may do one or more internal proofs until they have what they think is a good quality print, this is then sent to the customer for approval. The customer may approve this or suggest changes, which then involves a subsequent proofing cycle.

Through the proofing cycle the print shop and the customer collaboratively work up an understanding of what will be good enough for this job, given the various constraints and compromises. The priorities of the print job may emerge as the potential compromises become evident. In these cases (and perhaps more widely) the ‘perceptual intent’ of the customer is worked up collaboratively in the process of communication with print shop (rather than being pre-specified). Thus in many cases some proofing appears necessary, however a reduction in the number of proofing cycles, both internally and externally would be financially and temporally beneficial.

‘Ready to print’ jobs

As we have mentioned, there is a large category of jobs known as ‘ready to print’ which are submitted to the print shop in a state that theoretically means the print shop can just go ahead and print them. The estimate for these jobs is given without including any fee for work beyond production and finishing. In practice, many of these jobs actually do require some work and although the print shop would be within its rights to either give the customer whatever output came from the file or to charge the customer extra, there is often a reluctance to do this. This is because the print shops are operating under the constraints of the service provider-customer relationship in a competitive market, with its orientation to producing good quality work and building customer relationships.

Jobs that are provided to a print shop as “ready to print” can present obvious defects which are self-evident as such to the operator. Fig. 1 shows the output of a print-ready file where the page layout and creep settings⁴ have produced an image at the bottom of the page where the edge is printed across the spine of the booklet.

⁴ These ensure that images on book pages are positioned correctly in relation to the spine when it is assembled out of separate sheets



Figure 1: Creep and bleed



Figure 2: Unacceptable cast on paper rolls

The print operator can, and often does, make a judgment as to how serious a defect is and whether to proceed with a production run, given that such jobs do not foresee an exchange of proofs between the print shop and the client and/or extensive corrective work on the part of the print shop. It is reasonable after all to expect more tolerance on the part of the client given that they are not paying for the print shop's professional expertise in preparing the job. It is still possible, however, that the client will be disappointed with the results and, regardless of who is responsible for the defects in the final printed product, this can reflect badly on the print shop. This puts pressure on the print shop to do as much as is practicable to correct defective ready-to-print files. What that amounts to will depend on the relationship with and perceived importance of the client, whether further business depends on the client being satisfied with that particular job, etc.

There are also situations where the issue with a job is not self-evident to the print operator, often because it is a question of aesthetic requirements which have not been clearly communicated, and are therefore not visible as matters of perceptual judgment, to the print operator. For example, a company selling paper-making machinery submitted a job as ready-to-print and it was printed without any obvious quality problems, and consequently delivered to the client. Fig. 2 shows a page from this job. The client returned the job claiming the image quality was unacceptable, due to a yellow cast on the photographs which had a negative impact on the reproduction of 'white' paper rolls. This is a problem that the client clearly did not anticipate, so consequently did not give specific warning to the print shop. The print operator's own judgment can only go so far in trying to anticipate the client's preferences, and in this instance the cast, which is not unusual in pictures taken indoors with artificial lighting, was unwittingly aggravated by the client who encoded the file with an inappropriate colour space when creating the PDF file. Had the client expressed this priority from the outset, the print operator might have been in a position to instruct the client on how to better prepare the file for production, or negotiated to do it themselves. Ultimately the print shop agreed to reprint this job because this was a first-time client which they were keen to do more business with, but the job itself was run at a loss.

Of course by rights when the files do not print out as expected the print shops could charge the customer for them anyway, as the contractual agreement is for printing with no work. However, most print shops rely on repeat business and therefore work hard to maintain both a good relationship with the client and a good reputation. In addition, who may be held accountable is a somewhat fuzzy business – the print shop might say the fault lies with the clients files but if the client can see one thing on screen or on their own local printer this might be a difficult case to make. Problems with ready-to-print files are often additionally costly as not only is the cost of work on the print not included in the pricing, but the print shops might print the whole run before any problems are noticed.

Summary of colour workflow

Many troubles for the print shops originated upstream at the customer site; the customers were preparing files without usable colour management tags attached, leaving the print operators to try to get a good quality print using the resources available to them. This often required a compromise on some part of the document. The customers' and the print shops' workflows are poorly aligned and this causes problems for the print shops in terms of efficiently producing documents for the customer. The two ad hoc solutions that we have examined approach the problem from different angles. In the first, the print shops try to deal with the customers files as best they can as they receive them (or on an ad hoc basis), this gives them flexibility but requires extra work at the point of printing. In the second, the workflows of the customer were brought into line with those of the print shops, which produces greater predictability (for at least some parts of the job!) but reduced flexibility and required extra work in advance to standardise the two workflows. In both cases the bulk of the extra work was taken on by the print shops in the name of maintaining good customer relationships. Ideally a colour managed workflow would have avoided many of these problems, but *ideally* seems to be the operative word, since colour management is a system that print shops and customers seem unwilling and unable to implement.

In this paper we are examining the issues of printing, including colour, from the perspective of the print shop. Thus far our only access to the customers perception of colour comes through the proofing process, e.g. which files are accepted or returned. We would contend that what is important here is the print shops professional understanding of the customers' colour requirements which has developed over their years in service to and collaboration with their customers. However, in our ongoing work we are investigating document creation and in particular colour from the perspective of the document creators, that is the print shop customers. To this end we are investigating colour (colour preferences, perceptual intent, aesthetics etc.) as a situated activity, taking into account the different ways in which it is construed, measured, articulated and so on at different points in the document production process. We have reason to believe, drawing on

the work of Armour (1996) and Goodwin (1997) that the model on which colour management is based, that of communication of ‘perceptual intent’ and colour consistency across devices, may be based on a misconstrual of the way colour and aesthetic preference manifest themselves in practice. We hope to explore these issues further in future work.

The next section will examine how the files created at the customer site cause problems for the print shops in variable data printing.

Workflows for variable data printing

Similar to the problems in colour printing, we observed problems in variable data printing caused by the different, non-converging, workflows of the print shop and customer. Variable data printing refers to the printing of a unique printout for every member of a potentially large group of recipients. Text, images, and graphics can change for each printout. For example, an advertisement postcard may include text personalised for a specific recipient, pictures of products that the recipient might be interested in (based on past buying behaviour), and unique graphics which vary based on recipient and/or product characteristics. At the other extreme, only the recipients name and address may vary with all other text and graphics remaining the same.

We observed several kinds of problems with variable jobs at print shops originating at the customer site. One problem was the significant challenge of maintaining ‘data integrity’ (i.e. the right data in the right place) within variable print jobs. In jobs where images, text, and graphics can all vary at once, print shops and their clients must make sure the correct data lines up for each recipient (i.e. each recipient receives a postcard with the correct name, as well as the intended messages etc.). Data integrity is especially important in jobs where personal information like financial data is included. Sending personal information to the wrong recipient can lead to severe consequences, such as governmental fines in some countries or unintentional disclosure of personal information that could have legal repercussions.

Data integrity problems can originate at the print shop or in the customer files that are sent to the shop. The customer can send incomplete or inaccurate data and/or the print shop can make mistakes in their processing and assembly of the data into a printed piece. It is important to note that the data is not actually merged into the printed piece until after it reaches the print shop. Ultimately, print shops serve as the final checkpoint in ensuring data integrity, even though they have less background understanding to help them recognise problems. One way print shops attempt to address this issue is by sending a proof sample to customers for their approval. Print shops often collaborate with customers to determine what this sample should include. However, the sample may not capture all of the mistakes that may exist and time pressures can mean that proofing is not always feasible.

In addition to sending samples back to customers, print shops often conduct their own internal checks of data integrity, e.g. checking customer's data for missing data fields and problems with images. When information was missing from the data stream, print shops went back to customers to request the missing information. The process of preparing the files for variable data printing is a collaborative one, although perhaps one that might be considered as implicit collaboration, since the customers and the print shops do not explicitly set out on joint file preparation, rather it emerges in the course of the workflow. To illustrate, in Europe² a routine part of the work of client services, who received the file from the customer, was to check the data files, for missing fields, duplications (e.g. same name at same address) and so on. They would notify the customer of problems with the file, which the customer could then clean up and return, perhaps over a number of iterations.

Checking did not stop at this stage, however, pre-press would also check the file while working on it. In one example, client services had already received new 'cleaner' files from the customer for a letter inviting retail businesses to a conference and passed the files onto pre-press. The pre-press operator in looking at the data files, noticed that in one entry the same name 'Mr Tunnels' was in both the name field and the organisation field. The operator at first considered this was a mistake and went to remove the duplicated entry in the organisation field. However, he then reasoned that 'Mr Tunnels' might in fact be the name of a shop and left the entry in. This example illustrates the judgements that print shop workers must make; the data is somewhat ambiguous to them, being that of the client, yet they routinely carry out such checks and make such judgements.

We can see then that, as with the colour workflows, the print shop carries out work on the customers files to make them printable. Whereas some of this work is in collaboration with the customer, other work is hidden from them, with time constraints and so on meaning it is not feasible to take every 'little' thing back to the customer. There are a number of reasons why this work may take place: (1) the customer does not necessarily know exactly what the print shop requires to produce a good print job, not being party to their workflows; (2) because the merging of the data takes place at the print shop this may be an ideal time to check for problems; (3) since the print shop carries out this work, the client may take it to be part of the service. As with the colour printing described above, who is accountable for what is not always clear cut; for example, sending a letter out twice or with the wrong information may reflect badly on the customer, but also on the print shop. This type of integrity checking was not formally billed to the customer, but was instead another example of extra work performed by print shops in an effort to provide quality products for their customers. To several sites this additional quality checking was considered a value-added service and was considered necessary for customer satisfaction.

Co-creation and co-design

Another problem encountered by print shops is that customer data files did not always include all of the information and/or formatting that the shops needed to do their job. For example, one shop modified customers' files by adding the date that data was received and renaming customer fields to create consistency across jobs. They were adjusting the files to make them fit with their own workflows and in this way the files that were ultimately printed were often co-created by print shops and their customers.

One solution to the difficulties which caused by disparities between customers and print shops workflows is to take on responsibility for creation and design of files earlier in the process, typically at stages previously done by the customers. So for example, in US1 the print shop was printing a job which included variable images pulled from a master asset database. This job was a daily job in which new data streams arrived at the print shop every day. When a new data stream arrived, the print shop broke the data stream into smaller print jobs based on recipient information (and other parameters), and then integrated those jobs with the relevant subset of images from the master asset database. The print shop approached this process by creating image bundles for each subset of the data stream that was printed as a separate job. Originally, the print shop requested that the client provide the image bundles. The client owned the master asset database, updated it when necessary, and created and supplied the image bundles to the print shop along with the data streams. However, there were problems with producing accurate, timely bundles and to address these the print shop took over the master assets database, relocating it to the print shop site and enabling the customer to push files to the database via ftp whenever updates were necessary. The print shop then created scripts which examined the daily data streams and automatically created the image bundles necessary for each daily job. This new process worked better because the print shop had more detailed information about how the data stream needed to be subdivided, based on mailing regulations and other parameters that affected the creation of individual jobs from the daily data streams.

Discussion

The fieldwork described in this paper reveals the extra collaborative work that is needed to make the artefacts - print-ready files, data files, pictures and other content - from one workflow, the customer's, fit with a second workflow, the print shop's. Previous work has described how workflows of different organisations need to converge where the artefacts and processes of one have an impact on the other. When these processes are not smoothly aligned, extra 'management' work is required at and across the organisational boundary (cf. Bowers and Martin 2000; Lee, 2005; Martin et al, 2007). Our studies reveal that although this extra

work in printing can be described as collaborative in a broad sense (cf. Hughes, Randall & Shaprio, 1991), it is asymmetric in that the print shops take on more of the ameliorative work (on behalf of the customers) to ensure data, images and files print out well. Reasons for this include the competitive market place, the location of skills (print shops may be best placed to prepare files for their own workflow requirements) and, particularly in colour printing, the haziness that surrounds problem location and 'blame' assignment. Cases where customer and print shop form a more equal collaborative partnership to align their workflows are less usual. Taking the print shop's perspective, the question then arises as to how they might manage this asymmetry, and crucially, how might they reduce the amount of 'boundary management' work they take on, or charge for more for this?

Print shops in general deal with a wide variety of customers, with widely ranging requirements. From one-off jobs to long term repeated business, from basic to high quality, from simple to complex data, from 'concept-to-design-to-print' to 'ready-to-print'. There is just not the place for print shops to work with all their customers to standardise their practices and create 'boundary objects' to smoothly manage the business of printing – too much business is one-off or short term and is based on a model of minimal communication.

The route through which the manufacturers of printing technology (print devices, workflow systems etc.) have sought to assist in dealing with the great variety of customers has been to develop technologies that are meant to ensure an integration and standardisation of format and process across customers and print shops. For example, the technology of 'ICC colour management' is meant to facilitate this, as are workflow systems that are meant to reach out into customer operations or 'configure the customer' (guide and constrain them) through for example, a web portal. Thus far, as we have seen, these systems have not delivered on their promise. Among their problems being the fact that if technologies are going to be adopted and fully utilised, in a way that allows for smooth workflow from customer to print-shop, they need to be straightforward and painless (and cheap!) to deploy and operate, or to yield some other obvious benefits. For example, 'colour management' is complicated to deploy and operate and requires strict adherence from start to finish. Our evidence would suggest that there is not the will or the capability to properly deploy it within customers and print shops, save perhaps for a specialised few. In general, it must be noted that for many customers the 'extra' work that the print shop does on their files may be largely invisible, or only partially visible, and therefore be all part of the service. It is only in particular cases that the print shop will send files back. This makes the situation more complicated for the print shops to enforce process alignment, or start charging for the work.

When we look at the situations where workflows between customers and print shops have been aligned we can see that there are a number of shared features about these situations. Firstly, and maybe obviously, these involve long-term, re-

peat business customers, for example for the ‘HSC’ property job in Europe2, or the variable data job in US1, where the print shop took on the database management, scripting and so forth. In these cases the benefits are clearer to the customers (and to the print shops). In the HSC job, the work to set up the spot colour libraries benefits both – it makes the job easier for the print shop and ensures certain quality standards can be met within time constraints. In the US1 job the customer hands over the database management to the print shop which again helps ensure quality, and the print shop can charge extra for this enhanced service. Both situations have the benefit to the print shop of tying the customer in. And they hint at a potential tension in the situation for print shops – the current complexity of aligning workflows and reaching an agreed upon product is inefficient and sometimes costly when dealing with one-off or short term customers or ready-to-print files. However, it may be capitalised upon to charge a little extra to long-term customers or to at least ‘gear them in’ to a bespoke workflow and a contract – one they view as having been difficult to set up.

In fact, in many ways we now reach the heart of situation for print shops (and common in many service relationships). Long term, high value relationships pay better and are worth extra effort in setting up. However, these customers only make up some of the customer base in this industry – the question then becomes how to deal with the ‘long tail’ (Anderson, 2006), of many customers who sign up for one-off printing jobs, or cheaper ‘ready-to-print’ options, given that quality will remain crucially important. Technology seems like the obvious route to achieve quality control through standardisation, however, it has largely failed so far. Although we should note here that more complex online ordering systems are being put into place by some print shops, we have yet to see the impact of them. Although, in for example, Europe1, they were predicting troubles as the customer took on some of the work that had previously been done by the print shop. If, in the future, they needed the print shop to carry out that work, they would have to pay extra for it.

Thus far technologies like ‘colour management’ have been predicated on the idea that what customers want (their ‘perceptual intent’) for a printed product is necessarily or can be fully encapsulated in the file they send. Our research has shown that what a customer wants is often the product of a process of ‘rework’ and relative prioritisation given circumstances and contingencies undertaken collaboratively with the print shop. Given the difficulty of achieving the ideal of colour management it seems like it might be a more fruitful route to consider how to develop tools to accelerate the collaborative process of working towards an acceptable solution for both parties.

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