FROM BUREAU TO MICRO-INDUSTRY: A NEW STUDIO MODEL FOR DIGITALLY PRINTED CERAMIC ENAMELS

Steve Royston Brown

INTRODUCTION

This paper aims to provide a critical and contextual analysis of research conducted together with Martin Smith at the Royal College of Art in the field of ceramic printmaking during 2015–2018, and the subsequent reflections upon the four years since as we have continued to implement the research as a commercial print studio. Over these seven years, I was a senior research associate on the two AHRC-funded research projects: *Extending the Potential for the Digitally Printed Ceramic Surface*[1] and *Improved Laser Printing Equipment for Ceramics*[2], and design director for the spin-out ceramic design project, the print company Smith&Brown[3].

Digital design, combined with electrophotographic laser printing technology, has the potential to open up new market models and extend the visual language of ceramic tableware design but it has hit several barriers causing it to be dismissed by the ceramic industry, weak deposits and poor colour saturation being the most significant of these. Our research has contributed to resolving these issues by developing several technical innovations. These improvements have convinced key players within the industry; however, other barriers to the acceptance/implementation of the technology remain. This has led us to question this context and revise our original aims for industrial uptake, and identify new models more appropriate to the exploration of the market for the uptake of our research findings.

Alongside the findings of the research, the projects culminated in the presentation of two distinct pathways. First, a speculative enhanced bespoke ceramic printing system was determined as a proposal for industrial production[4]. Its specifications were developed through consultation with a consortium of key players and companies, using an existing model provided by the developments in ceramic inkjet technology for tile printing[5]. Second, a spin-out independent design project was established as a print company that could further support the industry's continued speculation through consultation but, more importantly, directly adopt an agile, dynamic studio approach to continue an exploration of the potential of digital ceramic printing within the commercial field.

Successful innovations were developed through the academic projects, but this approach remained, as Dr Peter Oakley described in his anthropological observation of the project, 'unfinished business[6]. Now, with four years of distance from the projects' industrial focus

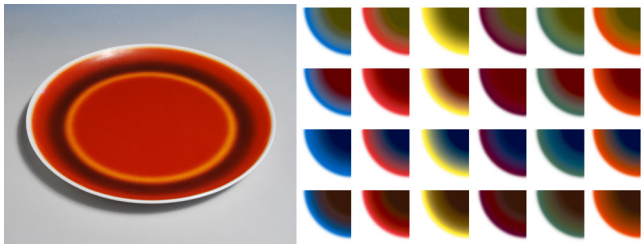

Figure 1

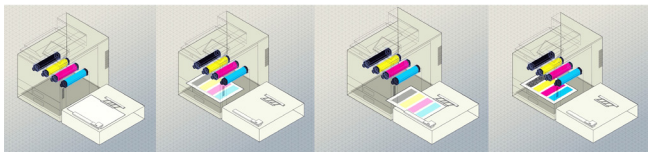

Figure 2

Figure Titles and Information

Figure 1: Ground-Merge plate prototype and colour blend test designs
Figure 2: Illustration of multi-pass laser printing of two layers

and with the research continuing in the form of an independent commercial print studio, a wider variety of market models have been explored and better insights are available.

REPURPOSING TECHNOLOGY

The history of developments in printing technology has many rich inter-contextual threads fed by ad hoc strategies[7] for repurposing materials and equipment and through leaps between and across disciplines, which have established new techniques and models for production. I have discussed, in past papers, examples of these influences on technological developments, including Guttenberg using ideas about repurposing equipment, such as fruit press and coin minting technology, that were at hand to develop letterpress[8], and how the early American pioneers of screen process printing, such as the Selectasine Co., utilised available flour sieving silk bolting cloths to provide a standardised mesh for screen-printed graphics in the advertising sector[9]. Developments made in the office printing field interesting to reflect upon in this context of he mutability of use as they also span outwards from their original purposes.

From the late nineteenth century, the demand from businesses to be able to produce immediate copies of administrative information produced a rich and varied lineage of printmaking innovations, such as Thomas Edison's mimeograph, and the Hectograph process, also known as gelatine duplication or jellygraph[10]. As businesses increasingly required their offices to have the ability to copy and print graphics, specialist printing equipment suppliers evolved new technologies to meet this new market. Innovations from companies such as Xerox and Canon developed complex equipment where photo matrix production and printing are all combined in one piece of equipment to produce immediate multiples of full-colour imagery.

Creative writers began to take notice of the possibilities for these immediate approaches in producing multiples using office printing technology. From the early days of the 20th Century, zines flooded the peripheries and reached beyond the mainstream of science fiction publication[11], with fanzines adding to this culture a little later, producing publications consumed by followers of bands following the explosion of music scenes. The use of office printing technology offered this sector a model which was small-scale, immediate, reactive and offered creative energy to sidestep the constrictions of mainstream[12] production.

The potential that photocopiers and laser printers offered als caught the attention of visual artists. Sonia Landy Sheridan, one of the most prominent artists of what became known as the Copy Art movement[13], began to explore the possibilities of using a state-of-the-art colour office printer during her 1970 residency at the research labs of 3M[14]. This artist's intervention with office-based systems led her to establish the Generative Systems programme at the School of the Art Institute of Chicago in the same year[15]. Here a succession of students led the way in repurposing office copy, print and

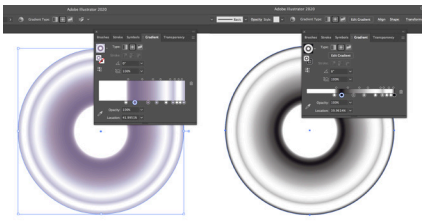

Figure 3

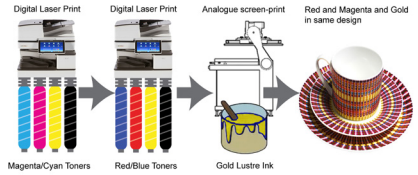

Figure 4

Figure 5

Figure Titles and Information

Figure 3: Ground-Merge IV artwork separations
Figure. 4: Illustration of multi-machine laser printing stages
Figure 5: Ground-Merge collection of prototypes at Top Drawer Olympia 2018

communication technology, opening up this black box equipment to offer new highly creative approaches to printmaking.

SERVICE BUREAU & PRINT-TO-DEMAND

Further innovations to emerge from office printing led to the establishment of the service bureau model and print-to-demand production. Prontoprint's bureau network was founded in 1971[16], rapidly becoming part of the high street, leading the way for other businesses to build upon this model, which would evolve to include the application of images onto a plethora of materials and objects. Established in 1973, another company, Landart Systems Inc., evolved their service bureau model around specific laser printers that were able to accept data input via a direct computer link or from magnetic tape. This development gave rise to a service named Laserlink[17], laying down the principles for sending files remotely through the Internet. This method eventually led to the establishment of companies such as Shapeways, who have extended this model to the remote production of 3D print-to-demand objects, launching their bureau service in 2008[18].

These frames of reference provide touchpoints for the context of the developments within our research focus, in terms of both the creative repurposing of office technology and the opening up of new market models such as the bureau and print-to-demand.

REPURPOSING LASER PRINTING FOR CERAMIC PRINT PRODUCTION

In the 1980s, an entrepreneurial German inventor/printmaker, Michael Zimmer, also became attracted to the potential for more immediate models for printing offered by office technology and began to explore what would happen if he replaced laser toner pigment with ceramic materials. The owner of an existing ceramic screen printing company, Zimmer was prompted by the economies of his business and imagined that automation, alongside the elimination of ink stock waste, could reduce production costs. Initially looking to inkjet print technology, attracted by the ease of re-loading pigments into cartridges, Zimmer became frustrated over the wear and tear of inkjet nozzles due to the highly abrasive nature of ceramic pigments and switched his focus to laser printers.

While the Copy Art movement had seen artists intervene with office equipment, this did not go so far as the pigment media itself. Electrophotographic laser printing overcame Zimmer's issues with abrasion because it is one of the only print techniques where the transference of an impression is neither pressed, pulled or squirted in highly physical ways. Yet, for the ceramic materials to be used, Zimmer needed to be able to 'tonerise' the dry[19] powder pigments, a process requiring laboratory conditions and specialist equipment. Michael Zimmer Toner Technologies was established in 1998 on the application for a patent for the ceramic tonerising process and

Figure 6

Figure Titles and Information

Figure 6: Dextral/Sinistral mug array

MZTT Ltd has since become the leading authority on ceramic toner production.

Zimmer's company then looked to establish its market and business model. One key avenue of growth was to grant licences to companies using their consumables. This led to the establishment of a small, global network of bureau services for digital ceramic prints[20] using the model laid down by earlier companies, such as Landart. A professional connection with ceramic industry expert Stuart Jones also led to a further partnership being established in 2001 with Digital Ceramic Systems in Stoke-on-Trent, the heart of UK ceramics production.

UPTAKE OF THE TECHNOLOGY

Zimmer continued to look to the printing equipment itself, to appeal to larger industry uptake and produce larger-scale prints, engineering various prototypes for specialist bespoke printers[21] while retaining the model of using repurposed office units for the majority of his business. Initial enthusiasm from the industry over the possibilities of the process was followed by disappointment concerning several issues. At first, the colours were limited to CMYK, excluding bright reds, while pigments failed toxic metal release levels, invalidating them for tableware use[22]. Zimmer's company looked to overcome these issues by extending the colour ranges available and eliminating lead, cadmium and selenium in specific ranges[23], but the initial wave of interest passed, resulting in MZTT and DCS consolidating their focus on servicing the bureau model. MZTT concentrated on toner production and DCS expanded into the tile mural sector where metal release was not an issue.

A small number of individual ceramic artists and designers engage regularly with the bureau model requesting one-offs and small runs, sending image files over the internet and receiving the printed transfers by return post using the Landart model. However, this approach obstructs the creative engagement with the print technology and decision-making during the process, which was the vision of the likes of Sonia Landy Sheridan's Generative Systems model of intervention. MZTT and DCS both offer printing packages for those who want to engage with the full system, and a few small companies have invested in fully equipping to print in-house but do not use the technology beyond simple, bespoke product personalisation, the technology essentially remaining within the service bureau model[24].

THE ACADEMIC RESEARCH PROJECTS

The Ceramics and Glass Programme at the Royal College of Art has, since the earliest days of its inception, made use of the digital prints offered through this bureau model[25]. Observing that some advances had been made over the years and yet there remained an obstruction in the uptake of the technology by the tableware industry, Professor

Martin Smith and I proposed to rekindle research aimed at this sector to reignite interest.

Our two academic projects spanned three years and, rather than use the technology as had become standardised by MZTT and DCS, we approached it as printmakers in the mould of the Emergent Systems model, opening up the closed standardised technology, intervening with and adapting it. We focused on exploring untapped capabilities of the technology to identify how it could exceed the capabilities of screen printing. We recognised and exploited design freedoms that resulted from treating digital surface design development more directly in tandem with ceramic transfer printing as a more conceptually and physically integrated process.

Digital ceramic transfer printing requires the toner to be printed onto specialist transfer paper stock, which has a release agent on the printing side. The four colours are deposited on the paper as it passes through the printer and the toner is fused onto the paper temporarily as it passes out of the machine. This last step demands the necessary innovation that MZTT made to be able to replace conventional toner pigments with ceramic versions. An additional analogue layer of covercoat is then screen-printed over the print and dried. When placed into water, the covercoat lifts away from the paper with the printed toner image and can then be positioned on the surface of a glazed ceramic object. Upon firing, the covercoat burns away and the pigment sinks into the glaze.

Our research resolved the issues of weak deposits and the limited colour range by developing an accurate multi-pass system, effectively reprinting the transfer paper in a selective, controlled way to apply and build up additional layers of heavier pigment deposits where required.

In addition to passing the transfer paper through the printer multiple times for increased saturation, we developed methods to allow an extended colour range to be printed on a single transfer sheet, made possible through the development of a micro-precision registration system. This opened up the potential to accurately pass a sheet through two laser printers using two different sets of the available gamut of toner hues[26]. In some cases, higher quantities of toner powder were delivered by retro-engineering and fitting 3D-printed, enlarged pipes to feed the toner pump.

Alongside this approach to adapt the physical printing equipment, we developed reprographic strategies which looked towards printmaking techniques that lay down colours through separate passes. This offered more complex strategies to tap into the unique visual language offered by laser printing to produce continuous tonal qualities in combination with selected areas of strong saturation[27].

The new micro-registration system also allowed the controlled application of further ink colours or precious metal prints by

registering the digitally printed sheets on a conventional screen-print machine. Alongside spot colours, this included the accurate registration for printing the covercoat layer, without which scales of the commercial production of ceramic transfers are not possible, this being one of the practical barriers to scaled uptake.

To further convince industry of the potential for this system, we designed several ranges of tableware collections and individual prototypes[28] which fully exploited the qualities that we untapped, including saturation, blends, Ombres, multi-colours beyond CMYK and digital/analogue hybrids. All of these results were exhibited at major trade fairs and captured in a short promotional film aimed at and shown to key industry personnel[29].

Throughout the two research projects, it became clear that, while we had successfully resolved many of the obstructions to the uptake of the technology by the ceramic industry, it was this model for the production itself that was the problem. Exploring other market models was beyond the scope and timeframe of the academic research and so we formed Smith&Brown as a commercial spin-out company and invested privately in taking our investigations forward.

There have, over recent decades, been seismic changes in the market sales of tableware. Past ceramic production models were based on the idea that a family would invest in a dinner service, with all the inherent replacements over a lifetime of use. While dinner services continue to be bought, this production has been significantly reduced as the market looks to more versatility within a tableware range, with mix and match and unique fast-fashion designs being bought. Large-scale industry requires a means to exploit this new smaller and more agile production demand, to meet these market models, yet the larger ceramic companies have little history or tradition of these approaches to production. In-house designers and printers have accumulated prodigious knowledge, methods and skills regarding the current production model of screen printing, all premised on systems and economies reliant on vast scales[30]. Success in this area requires the vision and approach of new models, such as the immediately reactive approaches premised by fanzine production and the artists at Generative Systems, or new possibilities of print-to-demand technologies as explored by the likes of Landart and Shapeways.

SMITH&BROWN: A MICRO-INDUSTRY MODEL FOR PRODUCTION

Since the academic research came to an end, Smith&Brown has continued to explore these alternative approaches. Our studio ethos embraces opening up the technology and working collaboratively with others to create surface designs through the strengths and weaknesses of the print technology itself, an approach influenced by smaller collaborative printing studios such as that established by Chris Prater at Kelpra[31] in the 1960s. It was not possible to take the bureau and

expand it to larger scales through industry, but the research is now finding a strong foothold using a micro-industry model.

The research here has revealed that larger industrial companies were unable to fully conceive of the potential of the new methods offered by the projects. Despite an appetite for change by the designers, and a desire to meet the demand for smaller targeted scales and to be more nimble with developing aesthetics through bespoke customisation and commission, too much in this context is still geared towards and invested in standardisation

This realisation has provided us with the impetus to shift our focus to collaborate with designers who engage from the ground up through digital design. This market turn has led us to work with companies, designers and illustrators such as Santorus Ltd, Yen-Ting Cho and Stephanie Fishwick, whose production model already employs digital methods of printing onto other substrates. The approaches to pre-press interpretation that we have developed fit well with their approaches, adding ceramics to their product folio. Our design developments involving layer strategies, Gaussian blur phenomena through photoshop or the blending tools of Illustrator have been successful in developing designs that these companies have launched at Decorex, shown at Ambiente and will feature at Maison et Objets Autumn 2022. Our collaborations with others have progressed laser-printed ceramic production beyond the service bureau model and, alongside our product ranges[32], have been finding a successful foothold within a micro-industry model.

We have aimed to take inspiration from and follow in the footsteps of those earlier printmaking individuals, cooperatives and movements who unpicked standardised print production models, repurposed and adapted printing equipment, and looked to market demands that mainstream print production could not meet to build a new studio model for ceramic and print production.

FOOTNOTES

1. https://www.rca.ac.uk/research-innovation/projects/extending-potential-digitally-printed-ceramic-surface/
2. https://www.rca.ac.uk/research-innovation/projects/improved-laser-printing-equipment-ceramics-ilpec/
3. www.smithbrown.co.uk
4. Details documented in project film: https://youtu.be/eU4G_6DfhqM
5. Ceramic Inkjet technology was developed by a consortium of companies providing solutions for: print machinery (KeramJet), Nozzles (ZAAR) and Printing ink (Torrecid). Our proposal followed this industry strategy
6. https://researchonline.rca.ac.uk/3184/7/Peter_Oakley_full%20paper_MF2017.pdf
7. Jencks, C & Silver, N. (1972) Adhocism: the case for improvisation. London: Martin Secker & Warburg Ltd.

8. Man, John. (2009) The Gutenberg Revolution: How printing changed the course of history. UK: Bantam.
9. Lengwiler, G. (2013) A History of Screen Printing: How an art evolved into an industry. Cincinnati, USA: ST Media Group International.
10. https://museumofprinting.org/blog/mimeograph-machines/ - Recently the Risograph print process has also been rekindled by artists' interest.
11. One early example is the 1939 science fiction fanzine Le Vombiteur, which used the Hectograph process also known as gelatine duplication or jellygraph.
12. The punk fanzine 'Sniffin Glue' epitomises this turn away from the mainstream. Successful uptake became quickly evident in 1976 as it started the year with 50 copies and ended it with a circulation of 20,000. The founder, Mark Perry, ceased publication fearing absorption into the mainstream - https://www.theguardian.com/music/2019/dec/10/how-we-made-sniffin-glue-punk-fanzine
13. Jurgens, C, M. (2009) The Digital Print: The Complete Guide to Processes, Identification and Preservation. UK: Thames & Hudson. P13
14. Ed. Sheridan, S. L. (February, 2014) Art at the Dawning of the Electronic Era: Generative Systems. Hanover, New Hampshire: Lonesome.
15. ibid
16. https://prontaprint.com/
17. "Interactive Printing Service Combines Xerox 9700, T/S System Formats". Computerworld. November 22, 1982. p. 51.
18. https://www.shapeways.com
19. The company and term xerox or xerograph, derives from the Greek for 'dry', a defining aspect of many electrophotographic (EP) processes: Jurgens, C, M. (2009) The Digital Print: The Complete Guide to Processes, Identification and Preservation. UK: Thames & Hudson. p.107
20. Along with Digital Ceramic Systems in the UK, the technology is available in the U.S. through licensing agreements from Design Point Decal, Inc. and Urban Clay Inc. Companies in a number of other countries also have their equivalent licensee agreements.
21. MZTT have successfully developed a bespoke wide-format digital ceramic laser printing machine: https://ceramictoner.com/en/large-format-ceramic-decal-print-service
22. https://oehha.ca.gov/proposition-65/proposition-65-list
23. https://ceramictoner.com/en/products/ceramictoner-sets
24. https://www.cornishware.co.uk/personalised
25. Alice Mara's 2003 master's graduate show at the RCA was a collection of plates printed using the technology: https://www.alicemara.com/about
26. Tableware safe ceramic toner hues available from MZTT include: Cyan Magenta Yellow Black Blue Red Rich Yellow Rich Black: https://ceramictoner.com/en/
27. Brown, S. Digitally Printed Tableware Prototypes – Including the GroundMerge collections of blend designs - https://researchonline.rca.ac.uk/3129/

28. Brown, S. Digitally Printed Tableware Prototypes - https://researchonline.rca.ac.uk/2742/
29. Brown, S. Film documenting results from the research projects - https://youtu.be/eU4G_6DfhqM
30. See case studies of ceramic print industry in: Brown, S. The Physicality of Print. (2011) https://researchonline.rca.ac.uk/id/eprint/1134
31. Prater, R. & Prater, C. (1980) Kelpra Studio: An exhibition to commemorate the Rose and Chris Prater gift. UK: Tate Publishing Ltd.
32. https://www.antitaupe.co.uk

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(Ref 1) - Extending the Potential for the Digitally Printed Ceramic Surface https://www.rca.ac.uk/research-innovation/projects/extending-potential-digitally-printed- ceramic-surface/

(Ref 2) – Improved Laser Printing Equipment for Ceramics (ILPEC) RCA website: https://www.rca.ac.uk/research-innovation/projects/improved-laser- printing-equipment-ceramics-ilpec/

(Ref 3) - For a full account of these barriers see Oakley, P. (2018) Creating a Brighter Future? Responses to the commercialisation of a new ceramic print technology Making Futures, vol.5.

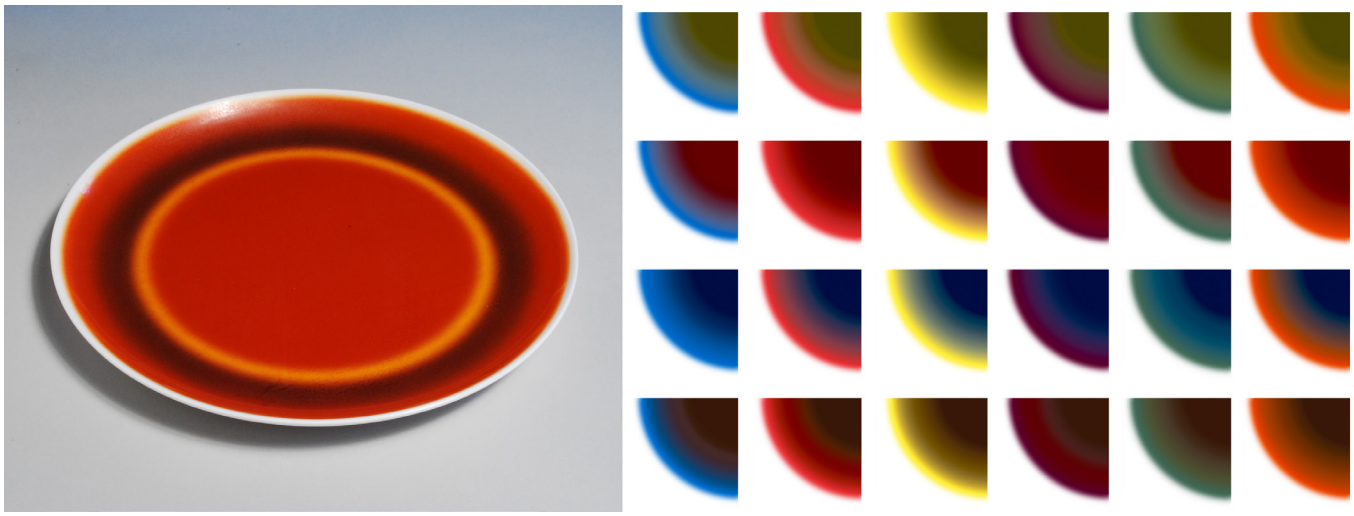
(Ref 4) - www.smithbrown.co.uk

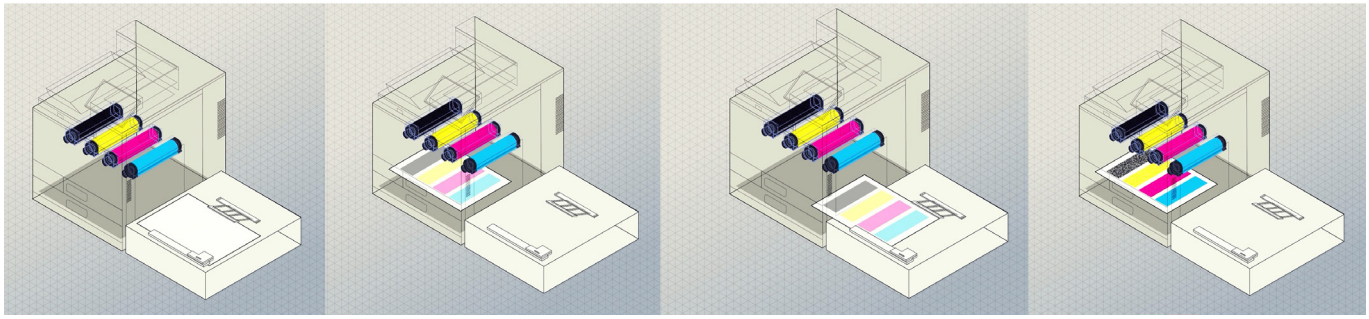
AUTHOR

Dr Steve Royston Brown

After an early career as a commercial textile printer, Dr Brown returned to education, completing his Masters and Doctoral studies at the Royal College of Art where he is currently Senior Tutor, on the Ceramics and Glass Programme. His multi-disciplinary printmaking practice has seen him exhibit nationally and internationally, drawing themes from the inherent language of print, focussing variously on the materiality and physicality of the image, and ideas around memory, seriality and hybridity. Dr Brown has completed three post-doctoral research projects, one of which focussed on developing new methodologies for restoration in the museum sector (V&A) utilising 3D print technologies, and two AHRC funded projects that explored the development of digital print technology within the context of commercial production for the ceramic tableware industry.

IMAGE GALLERY





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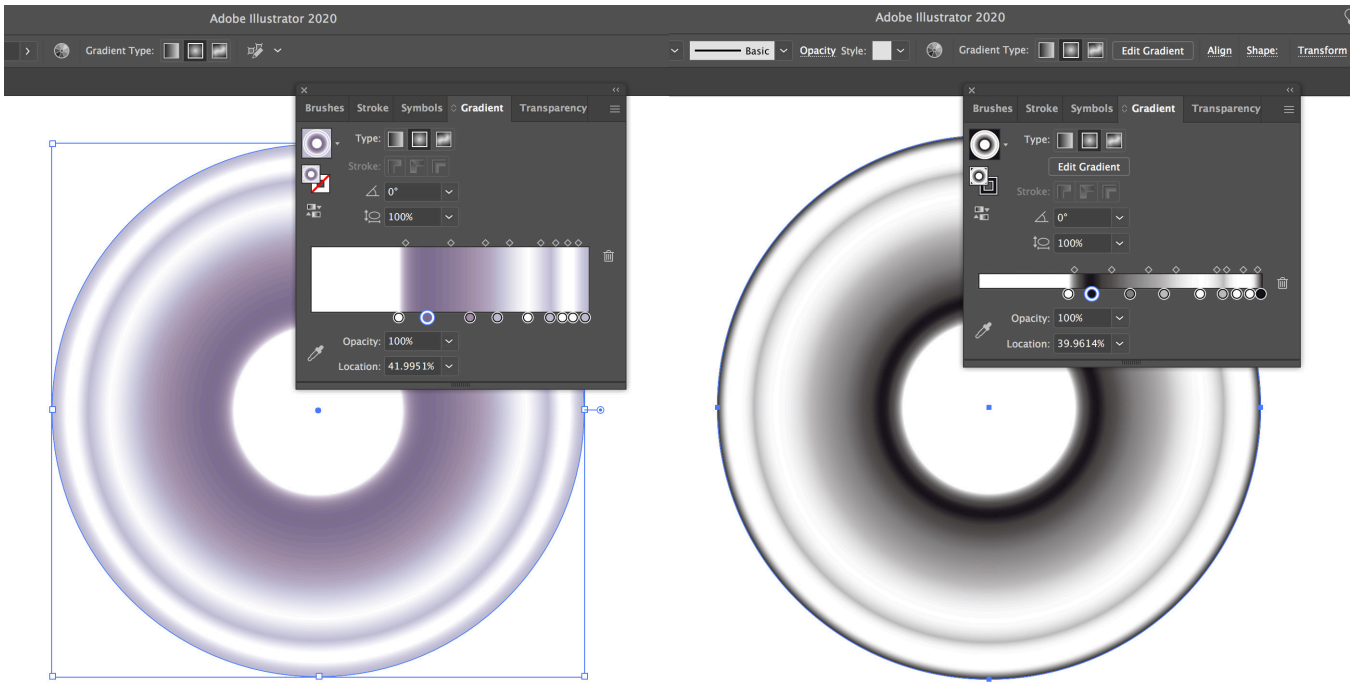

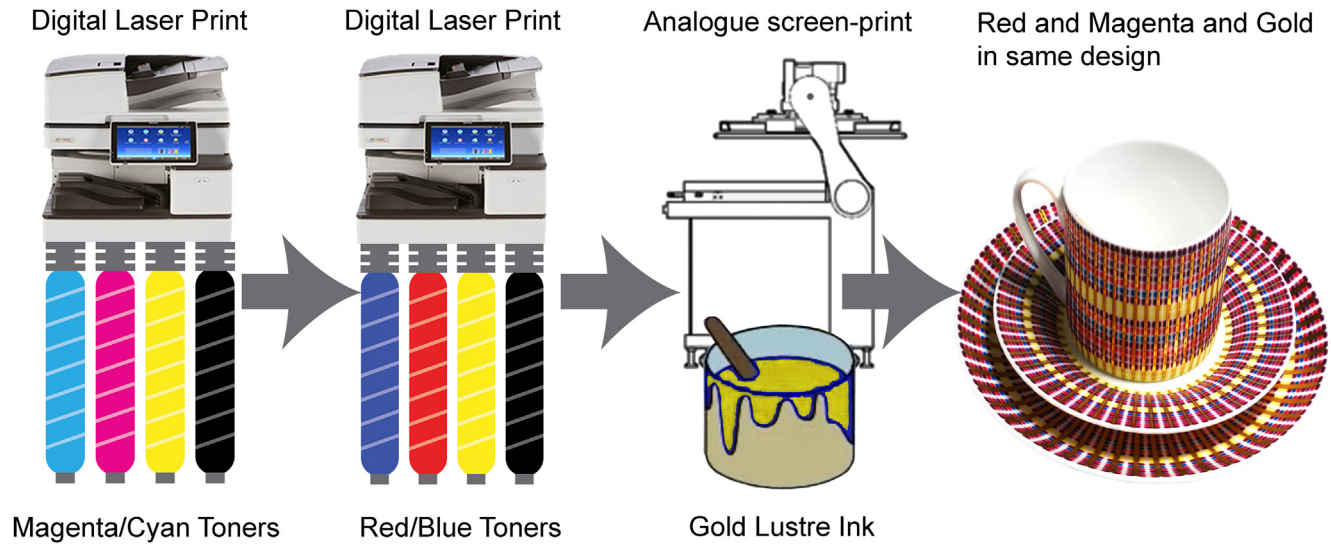

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