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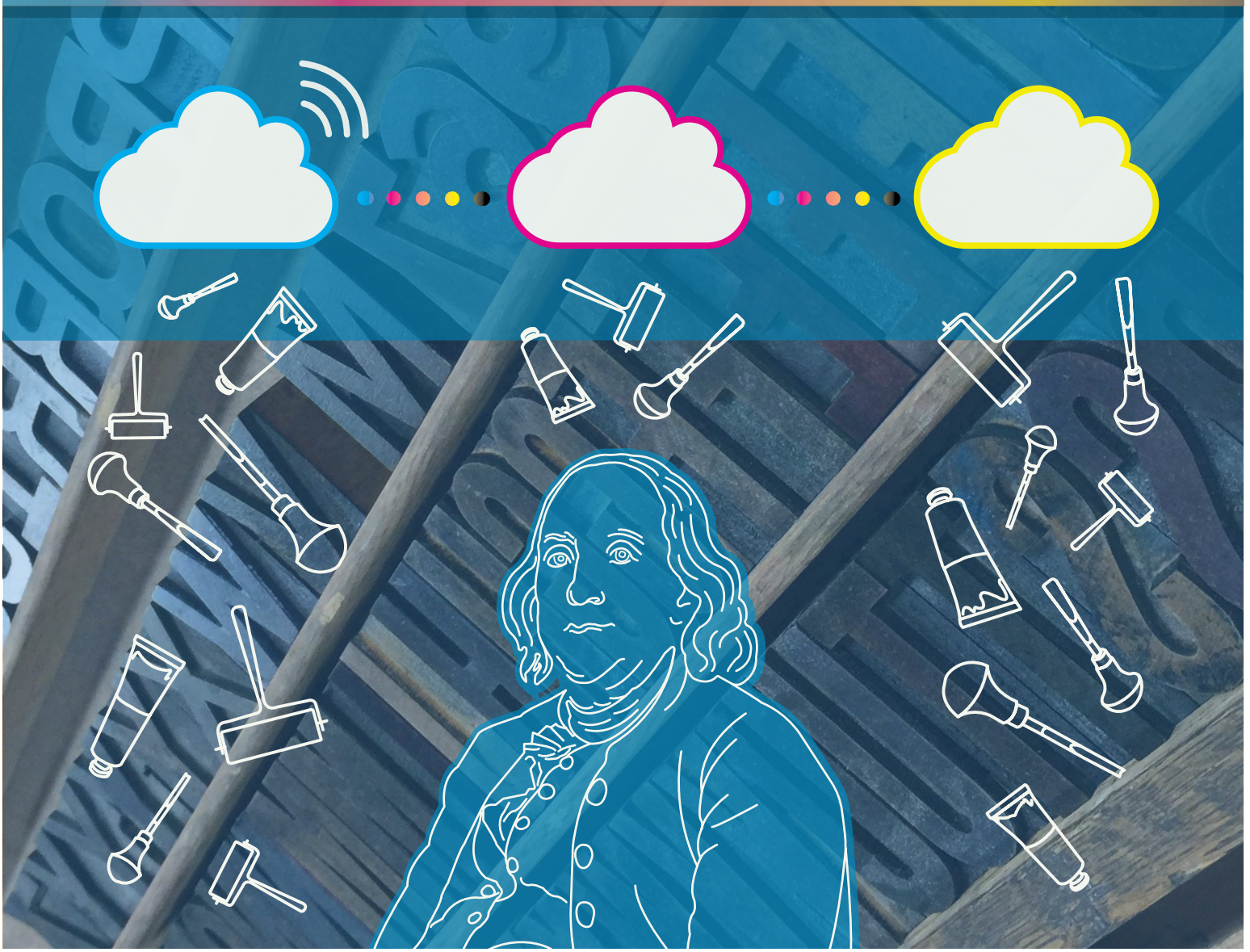
Printing Process Classifications and Printing Market Trends Composed into a Taxonomy Chart for Teaching

BRIAN LAWLER, M.S.



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Printing Process Classifications and Printing Market Trends Composed into a Taxonomy Chart for Teaching

by Brian Lawler, M.S. • California Polytechnic State University

Introduction

Explaining printing technologies to college freshmen can be a daunting task, and it can be difficult to translate an educator's enthusiasm for the various printing processes into terms that will interest a young adult. That task is complicated when all printing technologies are not available for hands-on learning. For example, unless students have access to a rotogravure press on-site, it's nearly impossible to give the students perspective about presses that are 30 yards long and four stories tall, and producing magazines at astonishing rates of speed.

In college, students study various taxonomies — in biology, and commonly in educational theory (like *Bloom's Taxonomy*). Presented here is the printing industry as a taxonomy, breaking the complex technologies into the taxonomic *Domains, Phyla, Orders* and *Classes* that are used in other fields of study.

Consider the numerous printing processes in the graphic communication industry as part of a large "living organism."

The Domains are: *Relief printing, Planographic printing Porous printing, Intaglio printing, Digital printing.*

There are some outlying processes, like magnetographic and mimeograph printing, that are included in those domains. They are included because they still exist, and because they should be represented in any study of the industry. For example, Riso, a Japanese maker of digital printers, continues to make the world's fastest desktop printer using *mimeograph* technology originally invented by Thomas Edison in 1880. Mimeographic printing falls into the domain of *Porous* printing.

The industry is first divided into five *Domains,* then further classified to include *Phyla*: the methods of printing that fall under each Domain, and which differentiate the various methods used in each process.

Order classifications break the processes down into narrower production segments, like dry-offset lithography. This process is relatively rare, but is made significant by the printing of aluminum beverage cans. Many billions of those containers are manufactured and printed annually, and they represent a significant part of the industry's output.

Class identifications include the finest detail of the analysis. Does the process use a film negative, as is still common in flexography? Or, does the process use a laser-ablated plate material subsequently processed by heat and sticky film to remove the non-image areas?

Over the years the taxonomy has been modified to add emerging processes. Such is the case with *production* inkjet printing, which has sprung-up recently. It was also revised to minimize processes that have been marginalized by changes in technology. In the early 1990s, for example, there were very few laser platesetters in North America. Today nearly every offset plate is made with a laser platesetter. Imagesetters (film) have been relegated to the back pages of Ebay (though they are still popular with screen printers).

The concept of superimposing dollar volumes on the taxonomy is also added. Unfortunately, it was difficult to get current dollar volumes, so those volumes were estimated with thick and thin lines representing sales in North America. In this most recent version of the taxonomy, more accurate sales volumes are superimposed over the taxonomy as lines of varied thickness in proportion to the sales in the specific process.

The result of this superimposition of sales on top of the processes is that the entire industry can be viewed as processes *and sales,* with the most significant processes having thicker lines on the taxonomy than those processes with lower sales. This taxonomy is then a visual indication of the amount of money spent on each printing domain, combined with the varied techniques used to produce printing in all of its forms.

As a teaching tool, this is easier to present to students than more traditional charts and graphs.

Flexography

After data were gathered, it became clear that flexographic printing is the dollar volume leader — by far — of all printing processes.

This is due to the volume of packaging printing. The total volume of packaging printing by flexography represents a a large percentage of overall printing. One must only visit a grocery store to see the impact of flexographic printing on the printing industry. Labels, flexible packaging, point-of-purchase displays, printed cartons are all com-

peting for consumer attention. In many cases, the graphics makes the sale to a greater degree than the product in the package!

Another factor making flexography a more important player in our industry has been the tremendous improvement in image quality made possible by ultra-high-resolution platemaking systems now available from Kodak and Esko. Where flexographic halftones were once relegated to the 100 lpi or lower range, it is now common to see halftone frequencies in the 150 lpi range and higher.

Highlight dot losses, once the weakness of flexographic printing, are now so low that micro printing is possible, with halftone dots held easily with printed dot areas of one or two percent. Such quality has made it possible for flexographic printing to rival the quality of sheet-fed lithographic printing.

Why would flexographic printing be so popular? How has it gone from nothing to the leader in just a few decades? The single most important reason is that flexography can use food-safe inks, where rotogravure and offset inks are made with solvents that are not safe for contact with food.

Rotogravure

Other trends in the printing industry show that processes once held to be incontestable for quality are now challenged by processes once considered unable to compete for quality. Rotogravure is the best example.

The *National Geographic* magazine, for example, was always held as the standard of quality for rotogravure printing. Today, complete signatures of that esteemed publication are printed by web offset lithography, and on close analysis it's clear that the offset signatures are at least as good as the rotogravure sections. Many believe that they are better.

Rotogravure printing has seen a continued drop in volumes. In the entire country last year only two new rotogravure presses were installed. But continued improvements in cylinder-making technologies have made the process more efficient and less expensive, making it possible for rotogravure to be more competitive against web-offset printing.

A small but significant segment of the package printing market is filled by rotogravure. That industry crows about how many cigarette packages and cartons it prints annually (about 3 trillion cigarettes were sold last year). Markets like that, as well as a successful market of shrink-tube packages, make up the largest share of the package printing component for the gravure industry.

Offset Lithography

Sales in sheet-fed offset lithography have fallen in recent years, most likely a result of the availability of fast and high-quality digital toner-based presses, and the shift of a large part of product marketing printing to the Internet and other electronic delivery methods.

It's fair to say that slow losses in sheet-fed markets have been picked-up by the digital sector, which shows an inverse slow growth curve that is almost the equal of those losses in sheet-fed offset printing.

Screen Printing

Screen printing continues to be an important industry segment. Printed garments remain one of the largest parts of that industry group, and sales continue to grow. Unfortunately, a small part of North American sales has moved overseas in recent years, eroding a growth curve that was stupendous just a few years earlier.

Industrial screen printing remains a growth industry, with many manufactured items printable only by the screen printing process. One segment of the industrial field, CD and DVD printing, has fallen sharply due to the shift in delivery of entertainment products from physical discs to online streaming.

Digital Printing

Digital printing is a growing phenomenon. Where five years ago it was inconceivable that a daily newspaper could be printed by ink-jet technology, that is happening every day in Chicago on a pair of TKS *JetLeader* presses. Short-run newspapers (some in Hebrew, Spanish and Greek) are a routine part of the production of Newsweb Corporation, which also runs long-run newspapers on its 64-unit Goss web offset press in the same building.

Stop the presses! The *Wall Street Journal* is looking at markets that can be served efficiently with an ink-jet edition of its famous business daily. Currently printed by offset all over the world, DowJones (WSJ's parent company) is considering the production of ink-jet regional editions for some of its smaller markets.

Color digital printing with toner remains a growth industry, with numerous machines now available that create printing that rivals the best offset sheets. The major players in this field are Xerox, Konica-Minolta, Ricoh and Kodak, all of whom produce production-speed digital

printers that are picking up the short-run commercial work from the sheet-fed industry.

And, in the field of toner-based printing is the powerhouse Hewlett-Packard, maker of the *Indigo* press line. HP likes to differentiate its products by insisting that *it's not toner* – it's *electroink* (toner suspended in mineral oil).

Regardless, the Indigo presses are making headway into markets formerly dominated by Heidelberg and Komori, and they are competing handily with flexographic presses for specialty and package printing. The impressive machines can make short-run printing at prices that are slightly higher than offset, but more efficient because they don't need plates, which take time and money to produce. The quality of Indigo jobs is almost as good as offset. Many say it's as good or better.

Light Amplification By…

If one takes a long look at technical developments in all printing processes over the past few decades, it's clear that one invention has made all the difference – the laser. At the core of almost every printing technology today, lasers make reliable, repeatable and microscopically small marks on a variety of substrates to make an image possible. Whether the laser is making a mark on the surface of a printing plate, or making a transient change in the electrostatic charge of an amorphous silicon cylinder, the laser is responsible for the evolution of all of our printing processes.

Printing today is visibly and measurably better than it has ever been. We are seeing stunning quality in every sector of our industry, and we are seeing that quality in all products produced.

Routine printing looks better today than at any time in history, and for those trying to make an even better product, our technologies now make that possible. No apologies are necessary for anything we produce. It's almost never a problem of being "good enough" when everything we make is so beautiful today.

This table shows sales volumes prepared as a column graph. Though it represents the same information on sales volume, the graph lacks process details, and does not present the information in an interesting format.

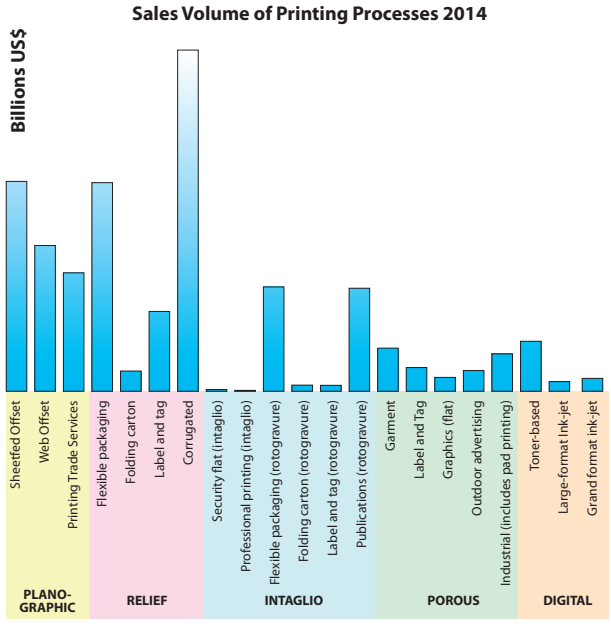

Figure 1

Printing is a Big Industry

The printing industry in the United States is a huge enterprise, and is one of the largest employers in the nation. These figures don't take into account the manufacture of paper or ink, nor do they account for postage, shipping, and distribution. Those would add significantly to the overall picture of this robust industry.

Data, presented in a variety of ways, tell a story in different ways. It is possible to take these same figures and to present them as a column chart, like the one in figure 1. The numbers are the same, and the impact on society is the same, but it is simply not very interesting to students.

Data, when presented in combination with other information graphically, tell a bigger story – one in which the various segments of the printing industry are described visually and with words. This is more interesting to students, and perhaps it will leave students with a better idea of what is happening in the graphic communication industry. It might better answer, "*where might there be employment in the future*"?

As with all things, time changes all of these factors, and this taxonomy is not likely to be complete, or ever really "finished." Instead, it is a glimpse of our industry today. In the future, an effort can be made to show *change,* because that is more important than any static snapshot of our industry.

The Reporting Climate

One of the most interesting aspects of making the taxonomy was the difficulty finding the data for our various industry segments. Multibillion-dollar differences exist in

published and unpublished claims of sales volumes in the industry, and it is difficult to find verifiable sales volumes for each category (domain) of printing.

Printing Industries of America (PIA) keeps sales volume records, but only for commercial and digital printing. Gravure Association of the Americas (GAA) does not keep sales volume records for its industry (or at least does not make them available). Flexographic Technical Association (FTA) has some general industry sales volume records. The Specialty Graphic Imaging Association (SGIA) has some industry sales volume records, but is constrained by trade regulations in making these data available.

Table 1: North American Printing Sales

	Billions US $
Offset	
Sheetfed Offset	32.60
Web Offset	22.64
Printing Trade Services*	18.39
Flexographic	
Corrugated	53.00
Flexible packaging	32.40
Label and tag	12.40
Folding carton	3.14
Intaglio	
Flexible packaging (rotogravure)	16.20
Publications (rotogravure)	16.00
Folding carton (rotogravure)	0.95
Label and tag (rotogravure)	0.92
Currency and Security printing (intaglio)	0.05
Professional printing (intaglio)	0.01
Porous	
Garment	6.70
Industrial (includes pad intaglio printing)	5.80
Label and Tag	3.68
Outdoor advertising	3.22
Graphics (flat)	2.15
Digital	
Toner-based	7.76
Grand format ink-jet	2.00
Large-format Ink-jet	1.50
Production ink-jet (data not available)	Unk.
Total	**$241.51**

* Binding and finishing, mailing (excluding postage), commingling, die-cutting, scoring, embossing, foil-stamping, gluing, etc.

Sources: U.S. Dept. of Commerce Census Bureau Data North American Industry Classification System (NAICS); various trade association publications including Infotrends, NAPL, GAA, and SGIA (see References).

Getting sales information from the U.S. Census Bureau (United States Department of Commerce) is fairly easy, but the data are suspicious and the categories are often obsolete. This is either the effect of companies not being classified in the correct *North American Industry Classification System* (NAICS) category, or that perhaps they are reporting in one category while they produce printing in several categories.

It would be much easier to get industry sales volumes if the various trade organizations conducted annual *anonymous* sales reporting surveys. The results of such surveys would be helpful to the members of each industry association.

There are also many printing companies in each segment that do not belong to the trade associations, and thus do not take part in any of their sales studies.

Private companies are also reluctant or unwilling to make their annual sales data available for various reasons. Companies in this category must put their business category NAICS number in their tax returns, but the dollar volume of printing may be buried in another category if they are not primarily a printing company.

Conclusion

Teachers are always working to make the material they present to students more relevant and engaging. The discussion of printing processes, while interesting to instructors, often fails to engage the interest of students. Add to that the challenge of teaching of sales volumes and putting big numbers into a format that is interesting.

By presenting complex information in a visually interesting format, it is possible to convey that information while presenting it in a way that is more easily understood and appreciated by students. For example, using the taxonomy one can see that corrugated packaging printing represents the largest volume of printing done in the United States. This information, communicated by a heavy black line, is easier presented graphically than in a table of numbers.

Instructors and their students will also appreciate the difficulty of gathering accurate sales volume numbers

from an industry that does not go out of its way to make these numbers available. Though exaggerated and hyperbolic comments are often made in print, and occasionally made at trade shows and conferences, the sales volumes collected by the U.S. Department of Commerce are reliable, and comparable to the figures provided by our industry's trade associations.

From this taxonomy students may also gain an appreciation for how our industry needs to change in the coming years to be more transparent about sales reporting and the public access of sales volume information so that the economic health of the printing industry can be monitored.

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SGIA (2015) *"2015 Specialty Graphics Industry Survey Benchmarking Report Garment Decoration Community"*

SGIA (2015)*"2015 SGIA Specialty Graphics Industry Survey Benchmarking Report Graphics & Sign Community"*

U.S. Dept. of Commerce Census Bureau Data *North American Industry Classification System* (NAICS). Sales volumes were derived from data in the following categories:

313310 Screen printing fabric grey goods and textile products (except apparel)

511110 Newspaper publishers and printing combined

511110 Publishers, newspaper, combined with printing

511120 Publishers, magazine, combined with printing

323111 Print shops, quick (except printing books)

323111 Printing, flexographic (except books, grey goods)

323111 Job printing, flexographic (except books)

323111 Offset printing (except books, printing grey goods)

323111 Commercial quick printing (except books)

323111 Job printing, offset (except books)

323111 Print shops, flexographic (except printing books)

323111 Job printing, engraving (except books)

323111 Commercial printing (except screen, books)

323111 Instant printing (i.e., quick printing) (except books)

323111 Printing, digital (e.g., billboards, other large format materials, high resolution) (except books, grey goods)

323111 Commercial digital printing (except books)

323111 Print shops, gravure (except printing books)

323111 Gravure printing (except books, printing grey goods)

323111 Print shops, lithographic (offset) (except printing books)

323113 Commercial screen printing

323113 Screen printing (except books, manifold business forms, grey goods)

323113 Job printing, screen

323113 Printing, screen (except books, manifold business forms, grey goods)

Planographic Printing

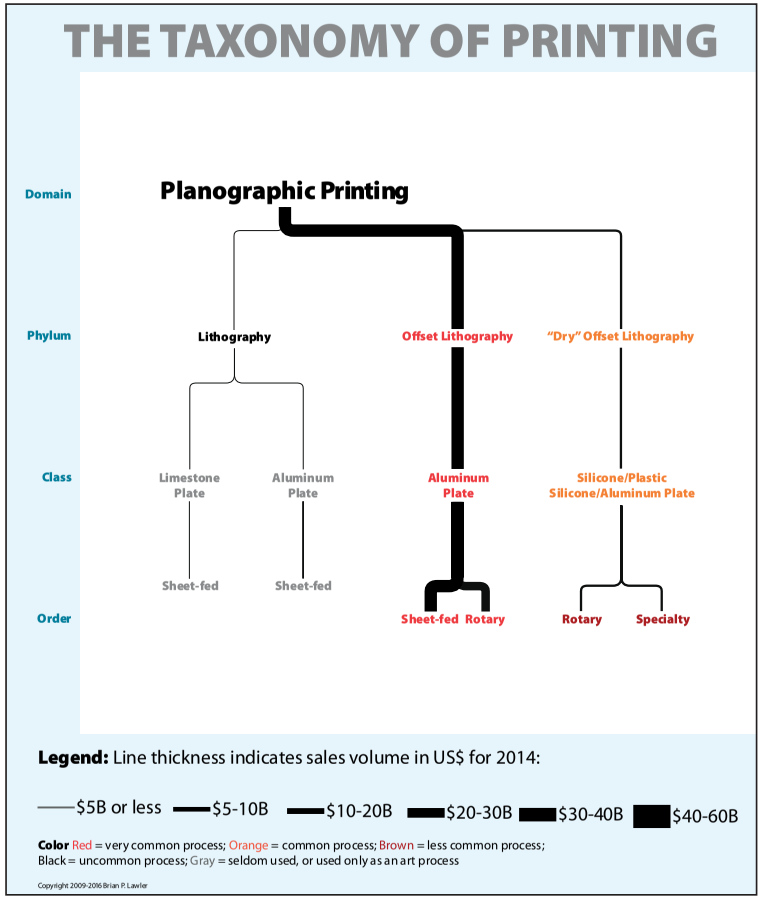

Figure 1

Relief Printing

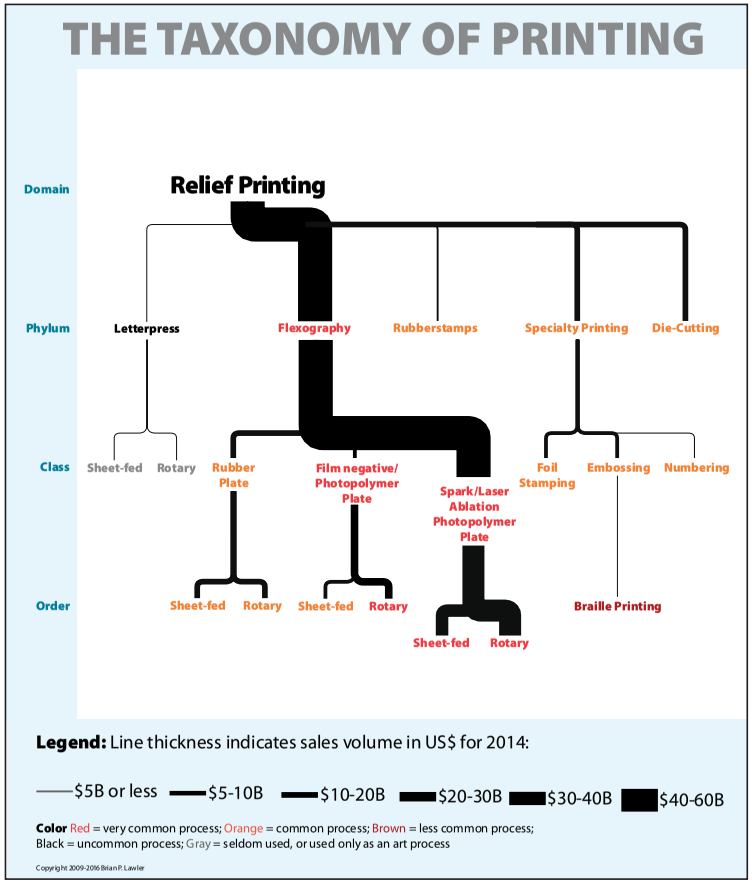

Figure 2

Intaglio Printing

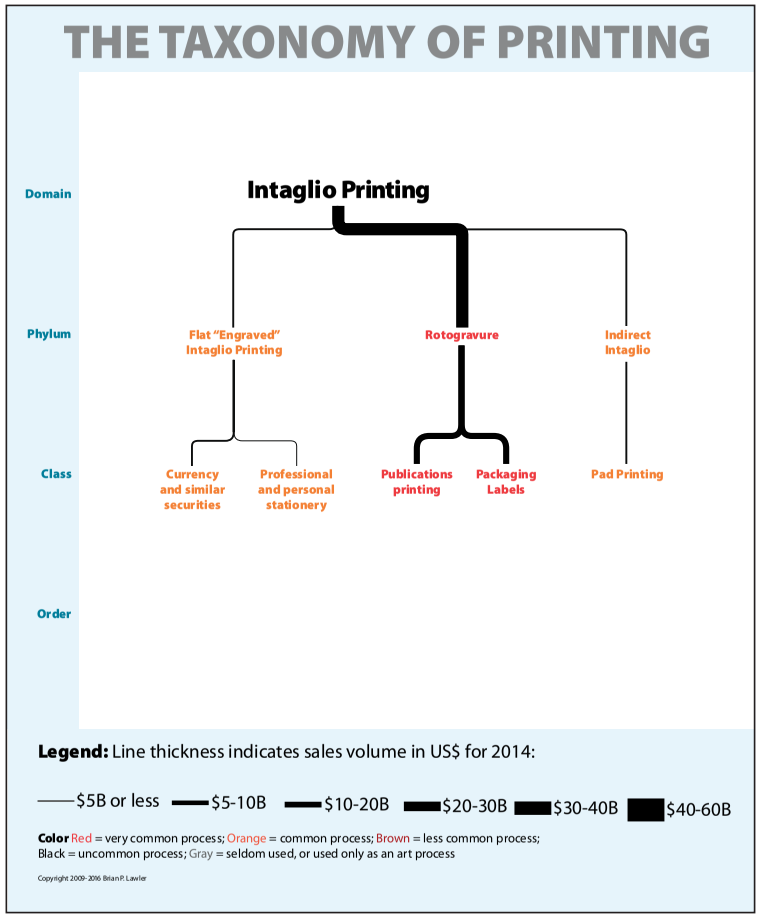

Figure 3

Porous Printing

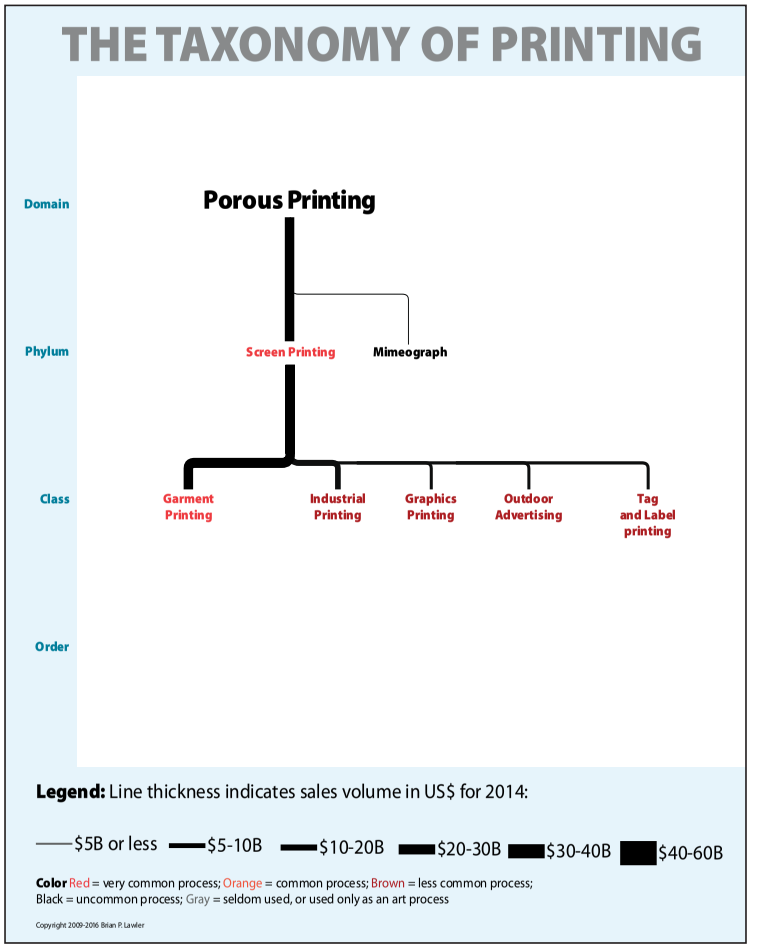

Figure 4

Digital Printing

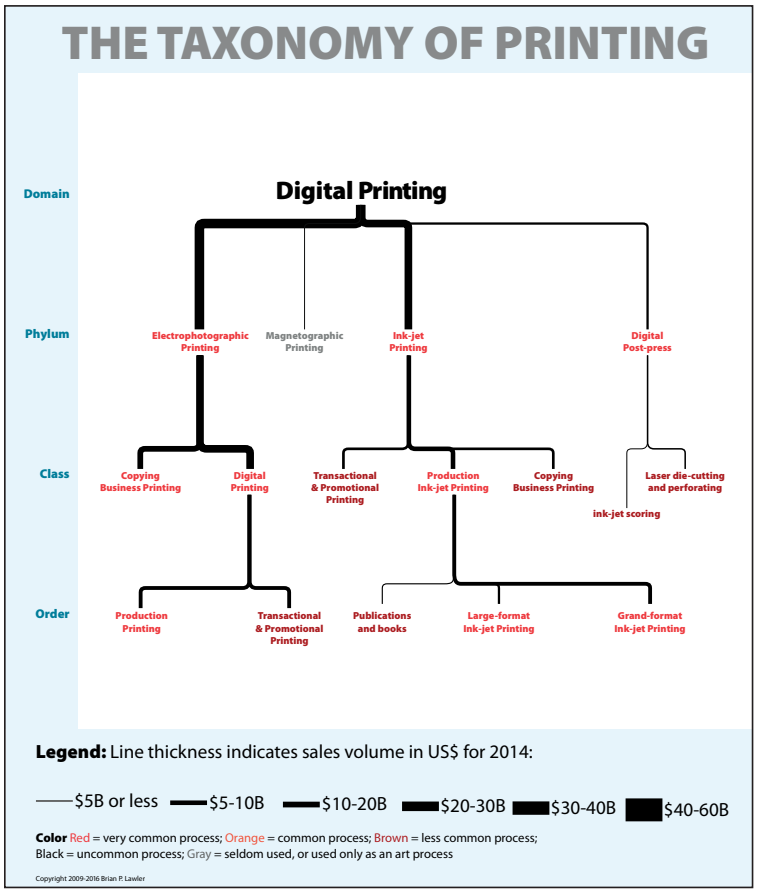

Figure 5

Manuscript Form and Style

- Prepare manuscripts according to the APA style, including the reference list.
- List your name and address on the first page only. Article text should begin on the second page.
- Provide a short biography for yourself that can be used if the article is accepted for publication.
- All articles must be submitted in electronic form on a CD-ROM or as an email attachment.
- Submit a Microsoft Word document, maximum of 10 pages (excluding figures, tables, illustrations, and photos). Do not submit documents created in page-layout programs.
- Word documents must have been proofread and be correct.
- Call out the approximate location of all tables and figures in the text. Use the default style "Normal" on these callouts. The call-outs will be removed by the designer.
- Use the default Word styles only. Our designer has set up the page layout program styles to correspond to those style names.
  - Heading 1
  - Heading 2
  - Heading 3
  - Normal

Graphics

- Be sure that submitted tables and other artwork are absolutely necessary for the article.
- Write a caption for each graphic, include captions in a list at the end of your Word document.
- Electronic artwork is preferred and should be in PDF or TIFF format.
- Send all artwork files and hard copies of these files with your submission.

Tables

- Set up tables in separate documents, one document for each table.
- Do not attempt to make it "pretty." Use the default Word style "Normal" for all table text. Do not use any other formatting.
- Do not use hard returns inside the table ("enter" or "return").
- Get the correct information into the correct cell and leave the formatting to the designer.
- Tables will be formatted by the designer to fit in one column (3.1667" wide) or across two columns (6.5" wide).

Artwork

- Scan photographs at 300 ppi resolution.
- Scan line drawings at 800 ppi resolution.
- Screen captures should be as large as possible.
- Graphics should be sized to fit in either one column or across two columns.
  - One column is 3.1667" wide, two columns are 6.5" wide.
  - Graphics may be larger than these dimensions, but must not be smaller.

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Audience

Write articles for educators, students, graduates, industry representatives, and others interested in graphic arts, graphic communications, graphic design, commercial art, communications technology, visual communications, printing, photography, desktop publishing, or media arts. Present implications for the audience in the article.

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All manuscripts must be received by the editor no later than December 15th to be considered for the spring *Journal* or by June 15th to be considered for the fall *Journal*. Include digital copies of all text and figures. Prepare text and artwork according to the instructions given in these guidelines. Be sure to include your name, mailing address, e-mail address, and daytime phone number with your materials. E-mail all materials to the editor (address shown below).

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